**Structure of Cyanobacteria**

Blue-green algae are the most primordial creatures in the plant kingdom, exhibiting typical prokaryotic organisation. A typical cell of blue-green algae consists of the following components:

1. Outer cellular covering.
2. Cytoplasm.
3. Nucleic material.

**1. Outer Cellular Covering:**

The outer covering of cell includes:

**(a) Mucilaginous layer**

The mucilaginous sheath is the cell wall's outermost layer. In certain circumstances, the mucilaginous layer is highly prominent and forms a mucilaginous sheath, whereas in others, it is inconspicuous. It defends the cell from environmental hazards.

**(b) Cell wall**

The cell wall is located just below the mucilaginous layer. Electron microscopy has revealed that the cell wall is a fairly complicated structure. The cell wall is made up of two or three layers, with the inner layer sandwiched between the outer wall layer and plasma membrane. Polysaccharides and mucopeptides are the building blocks of cell walls.

**(c) Innermost plasma membrane**

The plasma membrane is selectively permeable living membrane enclosing the cytoplasm and is lipoproteinic in nature.

**2. Cytoplasm:**

* The groundplasm, located beneath the plasma membrane, contains structures of various shapes and functions. Pigment-containing lamellae can be found in the cytoplasm's periphery region. Fine structure analysis has revealed that the pigmented lamellae are not organised into plastids. Lamellae or membranes are derived from the plasma membrane.
* Lamellae include pigments such as chlorophylls, carotenes, xanthophylls, c-phycoerythrin, and cphycocyanin, the latter two of which are uniquely found in blue-green algae.
* In addition to lamellae, the cytoplasm contains a number of membrane bound vesicles, which can sometimes be stacked in layers.
* Furthermore, ribosomes can be seen distributed throughout the groundplasm.

**3. Nuclear Material:**

* The nucleoplasm, or DNA-containing area, is centrally positioned in the cell and has a fibrillar shape.
* Nucleoplasm is feulgen-positive but does not form an electron micrograph of a cell's nucleus, implying that there is no nuclear border or nucleolus.
* During division, the nucleoplasmic material scattered throughout the cell divides in two, with no spindle apparatus involved.

**Reproduction in Cyanobacteria:**

Cyanobacteria reproduce asexually and the commonest mode of reproduction in them is transverse binary fission. In addition, there are certain specialized structures such as akinetes,hormogonia, hormocysts and spores, which are partly involved in the process of reproduction.

**1. Akinetes:**

In adverse conditions, most filamentous cyanobacteria form perennating structures (dormant structures). Akinetes are structures that are larger than vegetative cells and have thick walls. When favorable conditions return, they germinate and form new filaments.

**2. Hormogonia:**

* All filamentous cyanobacteria reproduce by fragmenting their filaments (trichomes) at about regular intervals to form short pieces containing 5-15 cells.
* Hormogonia are short filamentous pieces.
* The latter exhibit gliding mobility and grow into new full-fledged filaments.

**3. Hormocysts:**

* Some cyanobacteria create hormocysts, which are multicellular structures with thick and enormous walls.
* They can be intercalary or terminal, and they can germinate from either or both ends to produce new filaments.

**4. Spores:**

* Non-filamentous cyanobacteria produce spores such as endospores, exospores, and nanocysts, which germinate and give rise to new vegetative cells once the unfavourable conditions have passed.
* Endospores, like bacteria, are created endogenously; exospores are the consequence of exogenous cell budding, and nanocysts are formed endogenously, just like endospores.
* The distinction between an endospore and a nanocyst is that in endospore creation, the parent cell enlarges simultaneously, whereas in nanocyst production, there is no corresponding growth of the cell.

**Examples of Cyanobacteria**

* Cyanobacteria are aquatic and photosynthetic bacteria that use oxygen to make food.
* Blue-green algae are classified into a few genera, including **Aulosira, Nostoc, Stigonema, Anabaena, Spirulina, Oscillatoria, Syctonema, Gloeocapsa, and Chrococcus.**
* **Nostoc** is an aquatic cyanobacterium that produces food.
* **Anabaena** is a water-dwelling cyanobacterium that **can photosynthesis.**
* **Spirulina** is a cyanobacterium that is useful in both the **food sector and medicine.**
* **Nostoc sphaericum** is a cyanobacterium of the Nostoc genus that is popular in the cuisine of various Latin American countries, where it is known as cushuro. It has a spherical shape, gelatinous consistency, and antioxidant and antiviral activities, making it pharmacologically interesting.
* **Nostoc commune** is a type of global cyanobacteria that lives in damp soils, mosses, and grasses around puddles. Furthermore, these colonies have a gelatinous nature, which is why distinct forms of cyanobacteria in the genus Nostoc are often known as star jelly, spit of moon, or troll's butter, among other names.
* **Nostoc punctiforme** is a filamentous cyanobacterium that develops symbiosis and endosymbiosis with other species. It typically grows semi-elliptical colonies in damp yet smooth soils.

**Characteristics of Cyanobacteria**

* Cyanobacteria vary in size between species, with unicellular cells ranging from 0.2 μm to over 40 μm.
* Their only mode of reproduction is asexual, through the division of **vegetative cells.**
* Cyanobacterial cells can be **round, elliptical, barrel-shaped, cylindrical, conical, or disc-shaped.** Some taxa have cells of varying shapes. Cyanobacteria **lack flagella,** which are found in many other bacterial or **phytoplankton species.**
* The most widely dispersed group of algae, they can be found in marine and freshwater settings, wet soils, and rocks as free-living or parasitic organisms. The existence of gas vacuoles allows some planktonic forms to float, but the majority of filamentous forms have gliding motility.
* The structural spectrum includes unicells, branching and unbranched filaments, and unspecialized colonial aggregations surrounded by solid or amorphous mucilage.
* Numerically, these organisms dominate ocean ecosystems, with around 1024 cyanobacterial cells in the oceans.
* Identified as obligate photoautotrophic microbes. All blue-green algae are non-motile Gram-negative eubacteria. They lack a nucleus and organelles (chloroplasts, mitochondria).
* Polyhedral bodies (carboxysomes) contain RuBisCo (ribulose bisphospate carboxylase/oxygenase, the enzyme that transforms inorganic carbon to reduced organic carbon in all oxygen-evolving photosynthetic organisms).
* Circular DNA, no chromosomes, no histone proteins, 70S ribosomes, and smaller than eukaryotes.
* Cell walls are distinguished by a peptidoglycan coating.
* Reproduction is strictly **asexual**, with cells dividing or fragmenting the colony or filaments.

**Importance of Cyanobacteria**

* **Blue-greens are primary colonizers** on bare soil and rock; by forming mats that bind to the soil surface, they reduce soil erosion.
* As nitrogen-fixers, they contribute to **soil fertility** (e.g., growing in rice paddies, Anabaena, in association with the floating water fern, Azolla, increases rice production).
* Blue-greens contribute to the water plankton food chain; reef building, in tropical waters bluegreens precipitate calcium carbonate (limestone) out of water and build up rock layers.
* **Toxins: "blooms" of high concentrations in the sea kill marine fish, and in reservoirs they can cause gastrointestinal problems in cattle and humans.**

**FAQs on Cyanobacteria**

**1. How Long does Cyanobacteria Last?**

Cyanobacteria cannot maintain an abnormally high population for long and will rapidly die and disappear after 1-2 weeks.

**2. How does Cyanobacteria affect Humans?**

People exposed to cyanotoxins by eating contaminated food or dietary supplements, or by swallowing contaminated water. Neurological symptoms (for example, muscle weakness, dizziness).

**3. What Kills Cyanobacteria?**

Another treatment option is the antibiotic erythromycin, which will kill the cyanobacteria that cause slimy growth. However, the use of erythromycin can also kill beneficial bacteria in the aquarium and should be used with care.

**4. Can cyanobacteria cause death?**

Some cyanobacteria can produce cyanotoxins that can cause serious illness or death in pets, livestock and wildlife. These toxins can also make people sick, and in sensitive individuals also cause a red, raised rash or skin, ear and eye irritation.

**5. What kills cyanobacteria in water?**

Algaecides are chemical compounds applied to a waterbody to kill cyanobacteria and destroy the bloom.

**6. Can cyanobacteria fix oxygen?**

Cyanobacteria are the only diazotrophs (nitrogen-fixing organisms) that produce oxygen as a byproduct of photosynthesis and must deal with the presence of molecular oxygen using an anaerobic enzyme.

**7. Who discovered Cyanobacteria?**

The study of fossil cyanobacteria followed the discovery of Precambrian microbial fossils by S.A Tyler and E.S. Barghoorn in 1954.

**What Characterizes Cyanobacteria?**

**What are 3 Examples of Cyanobacteria?**

**What are 2 Characteristics of Cyanobacteria?**

**What is the Structure of Cyanobacteria?**

**What is the Structure and Function of Cyanobacteria?**

**What are the two uses of Cyanobacteria?**

**What is a Heterocyst?**