

Page No: Explain By: - Aniket Kumar. Topic: Cyanobacteria.

Long Type Question - 20 marks.

Introduction: Cyanobacteria formerly called "Blue Green Algae" are relatively simple, primitive life forms closely related to Bacteria as largest and one of the important group.

⇒ They are quite small and usually unicellular, though they often grow in colonies large enough to see.

⇒ They have the distinction of being the oldest known fossils, more than 3.5 billion years old.

Characteristics:-

① Cyanobacteria are relatives of the bacteria, not eukaryotes, and it is only the Chloroplast in eukaryotic algae to which the Cyanobacteria are related.

⇒ Symbiogenesis argues that the Chloroplasts found in plants and eukaryotic algae evolved from Cyanobacterial ancestors via endosymbiosis.

② Depending upon the species, Cyanobacteria can occur as single cells, filament of cells or colonies.

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(3) They are the most genetically diverse, they occupy a broad range of habitats across all latitudes, widespread in freshwater, marine and Terrestrial ecosystems, and they are found in the most extreme niches such as hot springs, salt works and Hyper saline bays.

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(4) They may be free-living or form symbiotic relationships with plants or with lichen-forming fungi as in the lichen genus *Peltigera*.

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(5) Some filamentous species show the ability to differentiate into several different cell-types: **vegetative cells**, the normal, photosynthetic cells are formed under favourable growing conditions, **akinetes**, climate resistant spores that may form when environmental conditions become harsh, and thick walled **Heterocysts**, which contain the enzyme **Nitrogenase**, vital for  $N_2$ -fixation.

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(6) Many Cyanobacteria form motile filaments of cells, called **Hormogonia**, that travel away from the main biomass lobule and form new colonies elsewhere.

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① Pigment System: Chlorophyll-a, Chlorophyll-b and Phycobili proteins.

Phycobili proteins are arranged in Phycobilisomes, (Hemispherical structures attached to PS-II)

i) Phycoerythrin (Absorption maximum at 550nm)

ii) Phycocyanin (Absorption maximum at 620nm)

iii) Allophycocyanin (Absorption maximum at 650nm)

Structure of cell: Cyanobacteria cells are larger and more elaborate than Bacteria.

Cell structure is typically prokaryotic - one envelope organization with peptidoglycan wall, naked DNA, 70S ribosomes and absence of membrane bound structures like - ER, mitochondria, Golgi bodies, plastids, lysosomes, Sap vacuoles.



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### ① Mucilage Sheath :-

i) Cells of most of Cyanobacteria have thin (Arthrocytic) or thick (Amphibena) mucilaginous sheath all around.

ii) This sheath is made up of microfibrils. These microfibrils are also scattered uniformly in matrix.

iii) It contains peptic acid and mucopolysaccharides.

### ② Cell wall :- Cell wall is of Gram negative type -

i) Cell wall has got 4 layers, known as LI, LII, LIII and LIV. The LIV layer is outermost layer, which is in contact with mucilaginous sheath while the innermost layer is LI and is in contact with cytoplasm.

ii) Cell wall is made up of mucopeptide, muramic acid, uracil, L-alanine, glutamic acid and  $\alpha$ -diaminopimelic acid.

iii) The layer LII provides shape and mechanical strength of the cell wall.

iv) All the layers are interconnected by plasmodesmata.

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(9) Cytoplasm: - Cytoplasm is covered by protoplasmic membrane. It is a semi-transparent membrane made up of protein.

⇒ Cytoplasm can be divided into 2 parts:-

i) Chromatoplasm: - It is the outermost part of the cell, which contains thylakoids or lamellae (flattened vesicular str.).

⇒ They are arranged in parallel rings or scattered.

⇒ They are flat, sac-like structures, enclosed by unit-membrane.

⇒ Each membrane is 70-80 Å thick. At their surface phycobilisome and biliproteins are present.

⇒ Apart from these structures, cytoplasm also contains Ribosomes, Cyanophycin Granules, polyulucan Granules, Carboxysome, polyhedron-Bodies, Gas vacuoles, polyphosphate Granules etc.

ii) Centroplasm: - Central transparent part of the cell is called centroplasm.

⇒ Genetic material is found in this portion.

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⇒ Genetic material is in the form of DNA.

⇒ Nuclear membrane, nucleoli and histones are absent.

⇒ In this para besides DNA, RNA is also present.

⇒ Thus in Cyanobacteria organised nucleus is not present, and this nucleus is called "incipient nucleus."

4) Cytoplasmic inclusions :- Several glycogen granules, oil droplets and other inclusions are dispersed in Chromoplasm as well as in Centrioplasm regions.

⇒ The main components include Gas vesicles, which promote flotation of the cell within the water column, Carboxysomes (polyhedral bodies), Deposits of the key enzyme catalyzing  $\text{CO}_2$  fixation, Ribulose-1,5 biphosphate Carboxylase/oxygenase (Rubisco), Cyanophycin granules, Consisting of a unique polypeptide built of L-arginine and L-aspartate residues and acting as an alternative nitrogen source, Granules of glycogen (α-granules), Lipids - Granules (β-granules) and Granules of poly-β-hydroxybutyrate acting as sources of

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Carbon and energy, and polyphosphate granules, Sources of phosphorus.

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⇒ They are also other inclusions, as well as various microtubules and microfilaments.

### Heterocyst of Cyanobacteria:

1) It is large-sized pale colored thick-walled cell which occurs in terminal, intercalary or lateral position in filamentous cyanobacteria. eg. Nostoc.

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⇒ The thick wall is impermeable to  $O_2$  but permeable to nitrogen.

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⇒ Mucilage sheath is absent.

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⇒ Photosystem-II is absent.

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⇒ Thylakoids lack phycobilisomes. Therefore, photosynthesis is absent but cyclic photo-phosphorylation occurs.

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⇒ Heterocyst is dependent for its nourishment on adjacent vegetative cells.

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⇒ It has enzyme nitrogenase. Heterocyst is specialized to perform nitrogen fixation.