CYANOBACTERIA

- a division of microorganisms that are related to the bacteria but are capable of photosynthesis. They are prokaryotic and represent the earliest known form of life on the earth.
- **Cyanobacteria**, also known as blue-green bacteria, blue-green algae, and Cyanophyta, is a phylum of bacteria that obtain their energy through photosynthesis.

OCCURANCE OF CYANOBACTERIA

- Cyanobacteria or blue green algae are the one of most successful autotrophic organisms on earth which have mastered all types of environments— fresh water, sea water, salt marshes, moist rocks, tree trunks, moist soils, hot springs, frozen waters.
- Cyanobacteria are the most self contained photosynthetic organisms. They can, therefore, live under every type of environment and on every type of substrate. Because of this fact, they are one of the earliest colonizers of barren areas. Many of them have the ability of nitrogen fixation.
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ORGANISATION OF THALLUS

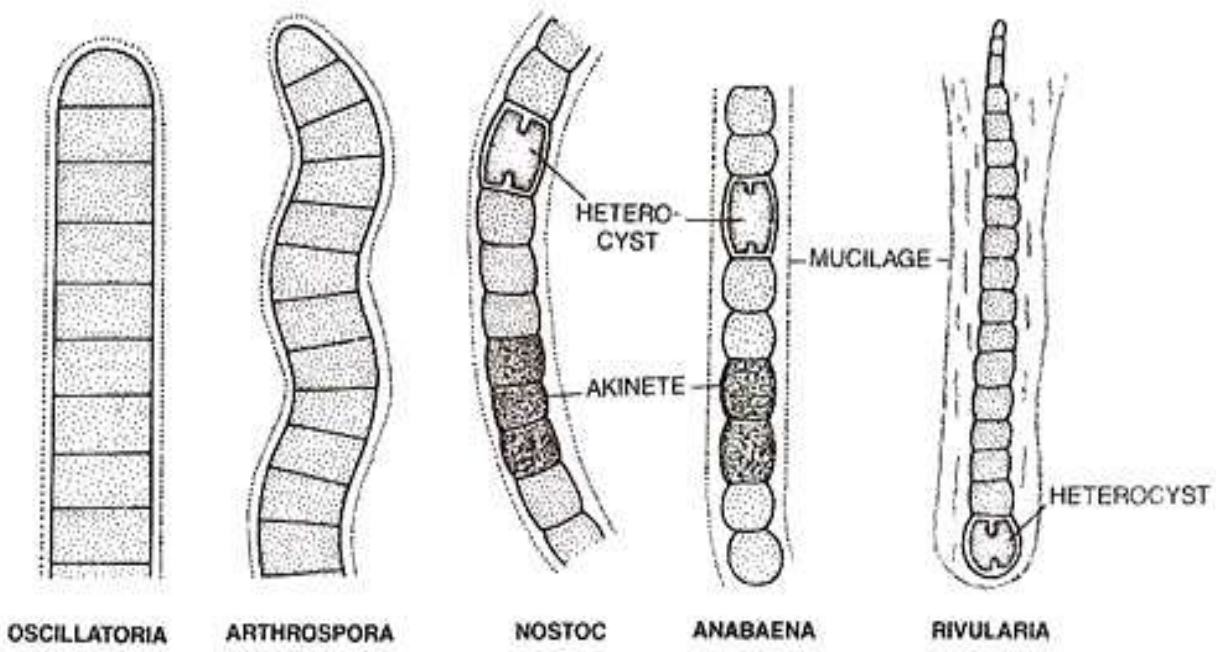


Fig. 2.17. Some common filamentous blue-green algae.

ORGANISATION OF THALLUS

- The organisation of thallus ranges from unicellular to branched heterotrichous forms:-

i)Unicellular forms e.g.,*Chroococcus,etc*

ii)Unicellular polar thalli with a definite base and apex e.g.,*Dermocarpa*

iii) Multicellular colonial forms e.g.,*Gloeocapsa*

iv)Simple unbranched filamentous forms without heterocysts and akinetes e.g.,*Oscillatoria*, *Spirulina*

v) Simple unbranched filaments with heterocyst, e.g.,*Nostoc*, *Anabaena* etc.

vi) Unbranched heterocyst filaments with base and apex, e.g., *Rivularia*, etc.

vii) Heterotrichous filaments with false branching,e.g., *Plectonema* etc.

viii) Heterotrichous filaments with true branching, e.g., *Stigonema* etc.

CELL STRUCTURE

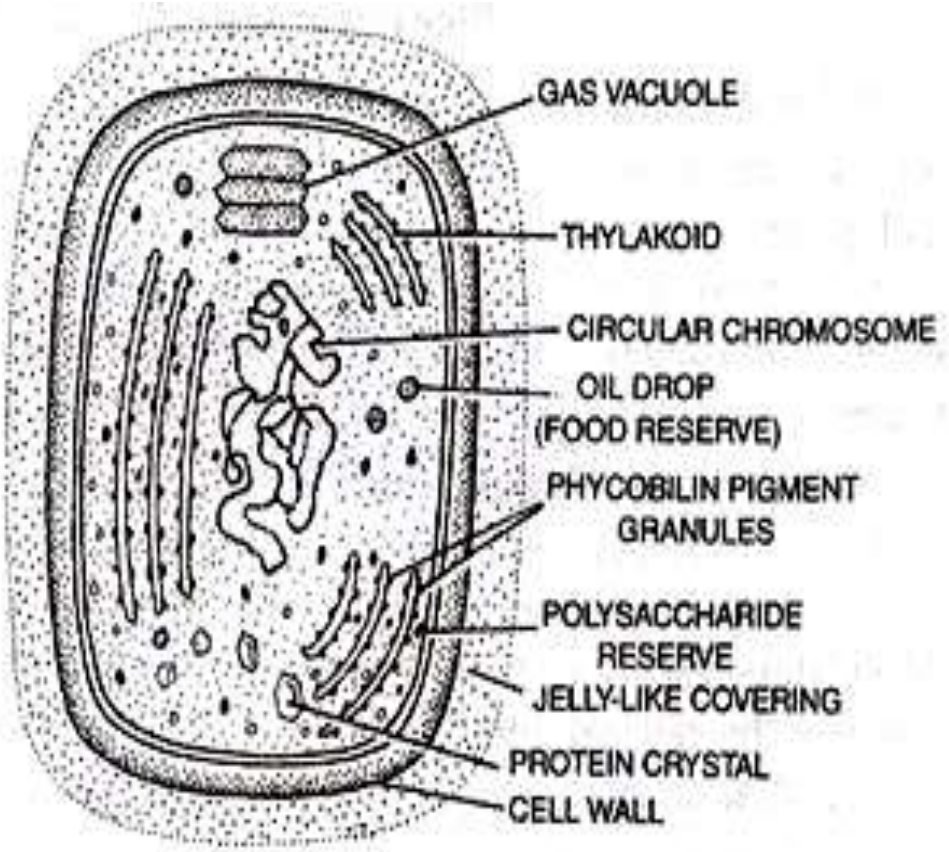


Fig. 2.18. Ultrastructure of a cyanophycean cell.

CELL STRUCTURE

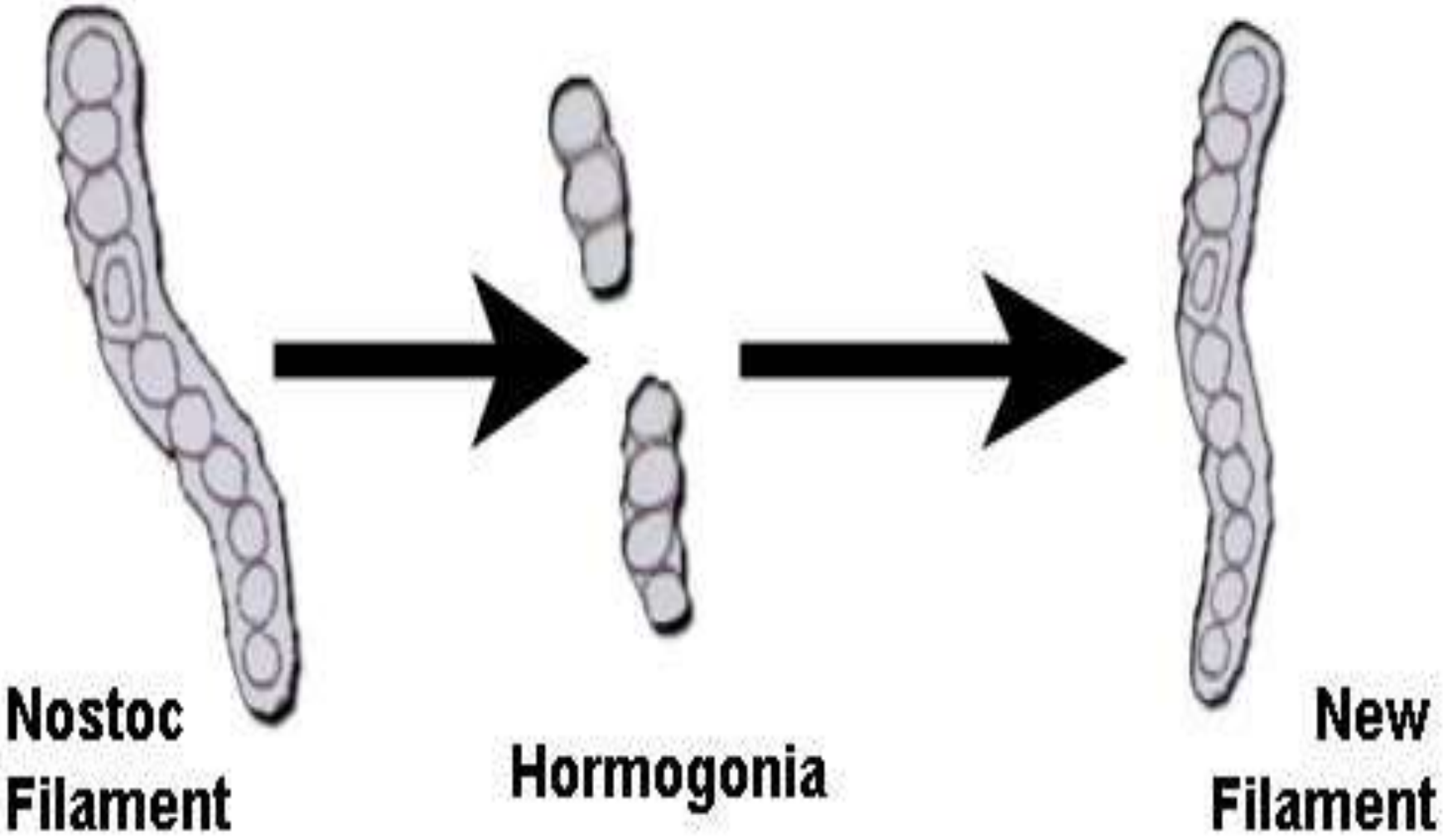
- All cyanobacteria except ***Gleobacter violaceus,*** have an internal system of thylakoid membrane in which the light reaction of photosynthesis and respiration occur.
- Besides the thylakoid membrane the cyanobacteria cytosol contains components such as carboxysomes, glycogen granules, cyanophycin granules, lipid bodies, polyphosphate bodies.
- Cyanobacterial cells are more elaborate and larger than bacteria.
- Cyanobacteria have typically prokaryotic cell structure naked **DNA**, 70s ribosome, one envelope organization with peptidoglycan.
- Membrane bound structure like endoplasmic reticulum, mitochondria, Golgi bodies, SAP vacuoles, plastids are absent in cyanobacteria.
- Cyanobacteria cell wall is four layered with peptidoglycan is present in the second layer.
- The gas vacuoles are common in planktonic forms. They are vesicles filled with gas and bounded by single membrane.
- There is no mitotic cell division in cyanobacteria. The cells divide by fission or amitotic division.

NUTRITION

- Cyanobacteria contain chlorophyll a and other photosynthetic pigments.
- They synthesize their own carbohydrate food from carbohydrate food from carbon dioxide and water in presence of light by the process called oxygenic photosynthesis.

Reproduction

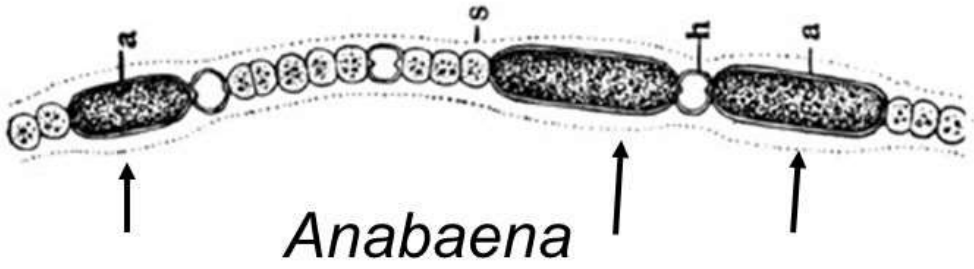
- **Cyanobacteria employee's variety of mechanism with respect to reproduction:**
- Binary fission.
- Budding
- Fragmentation.
- Multiple fission.
- Fragmentation of filamentous cyanobacteria form small, motile filaments called **hormogonia**.
- Some cyanobacterial species develop **akinetes,** specialised, thick- walled dormant resting cells that protect the organism in unfavourable conditions.
- Cyanobacteria lack the enzyme **alpha ketoglutarate dehydrogenase**, thus they do not have a fully functional citric acid cycle.


Nostoc
Filament
Hormogonia
New
Filament

Cyanobacteria: systematic characters

Vegetative reproduction:

Akinetes: resting cells with thick cell walls and enriched with storage products

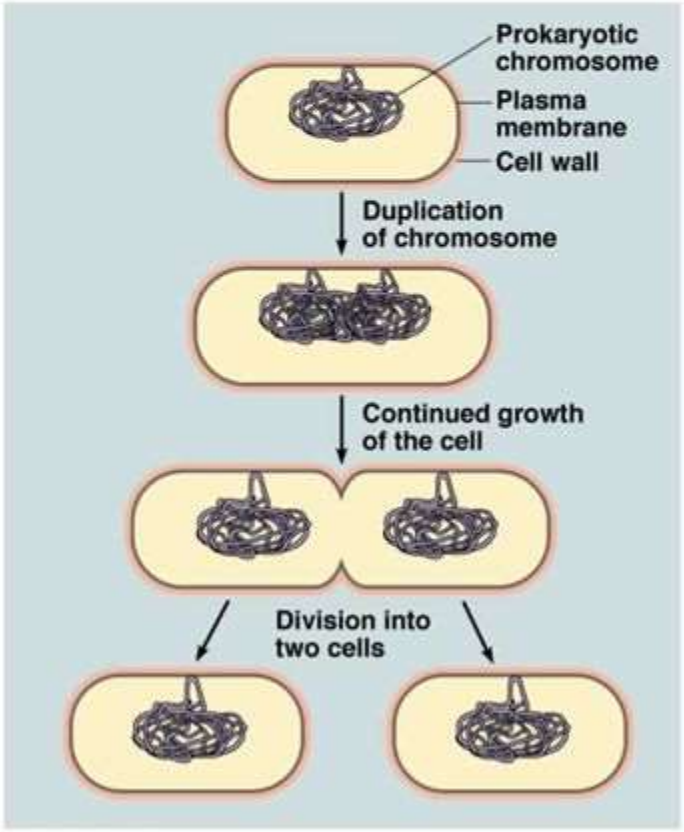


Anabaena

Akinetes may survive for years in darkness and under dry conditions

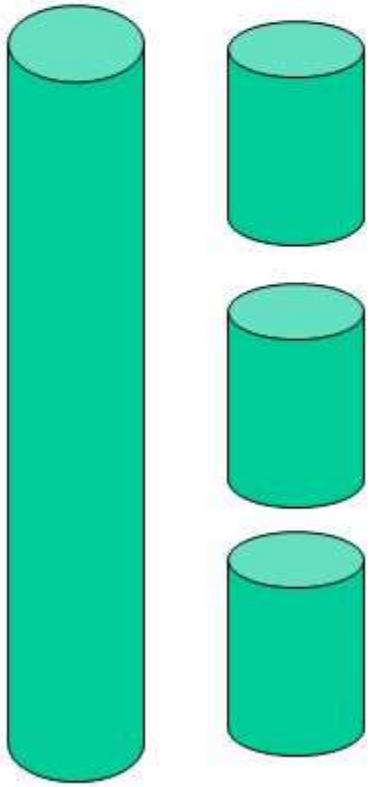
Reproduction of Cyanobacteria

- **Binary fission**

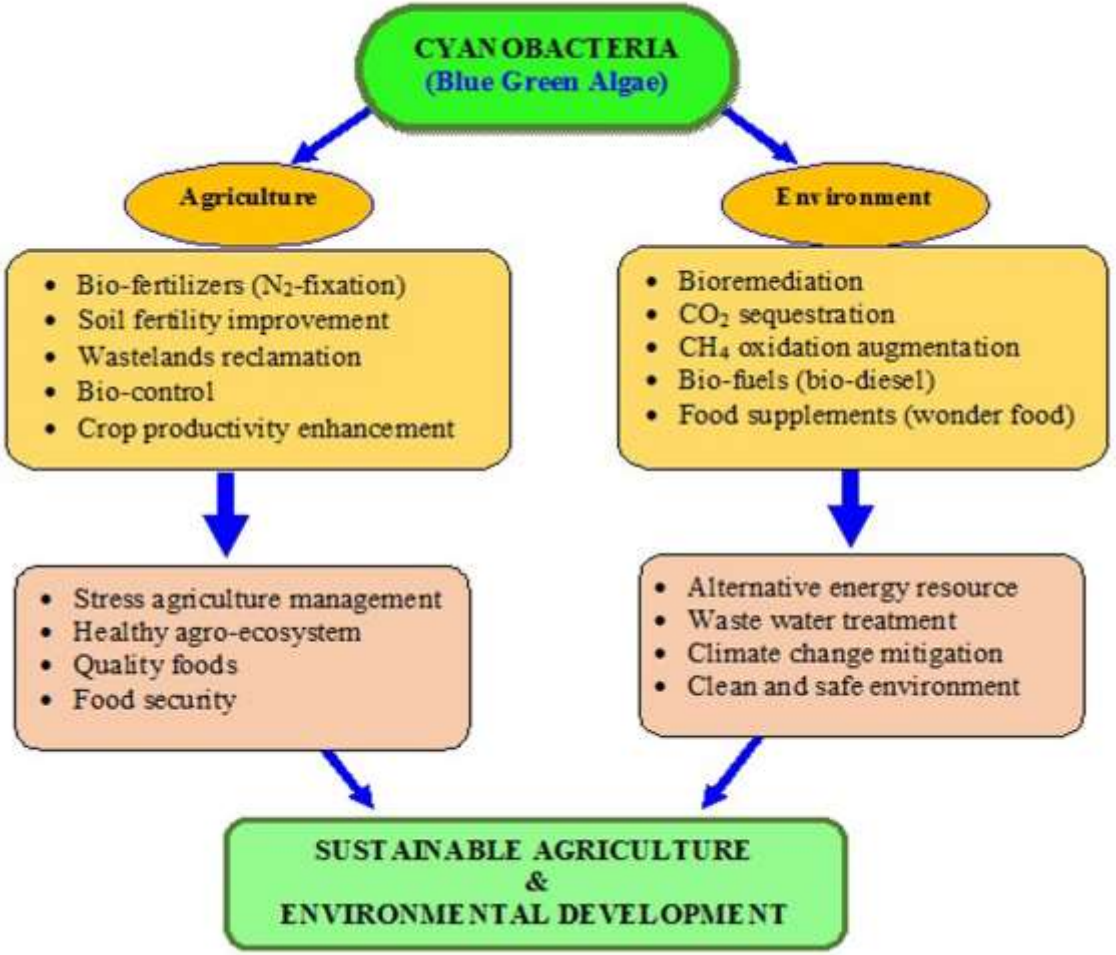


- **Budding**

- **Fragmentation**



Economic Importance of Cyanobacteria



OSCILLATORIA

OSCILLATORIA

- **Oscillatoria** princeps is the type species (lectotype) of the cyanobacterial (blue green algal) genus **Oscillatoria**. The cyanobacterium is dark blue green in colour.
- Oscillatoria is a genus of filamentous cyanobacterium which is named after the oscillation in its movement. Filaments in the colonies can slide back and forth against each other until the whole mass is reoriented to its light source.

Some common species of Oscillatoria

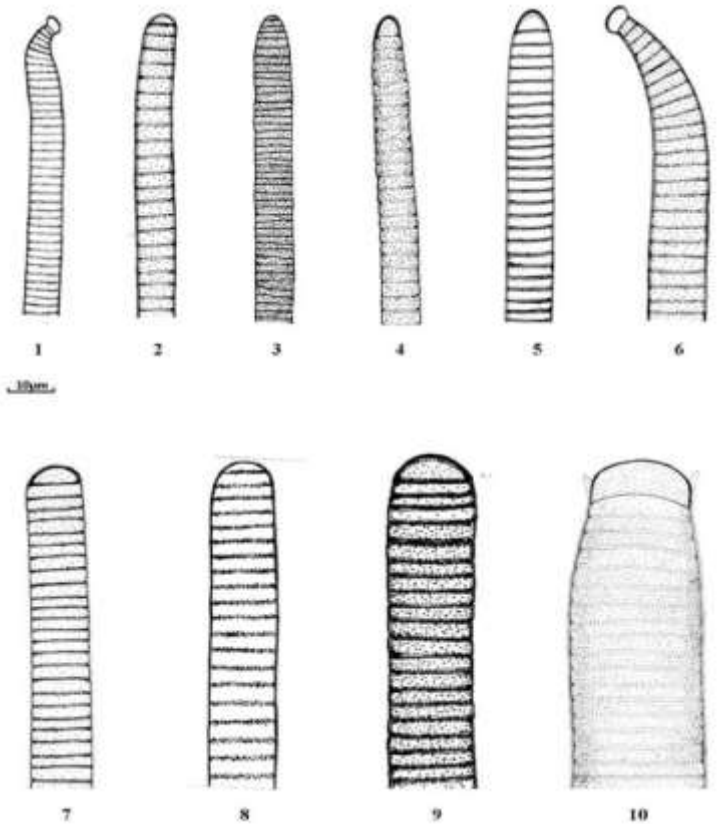


Plate 1: Figures 1-10 *Oscillatoria Vaucher*
1: *O. anguina 2: O. tenuis 3: O. subbrevis 4: O. nigro-viridis 5: O. vizagapatensis 6: O. proboscidea 7: O. sancta*
8: *O. limosa 9: O. margaritifera 10: O. princep*

Occurance of Oscillatoria

- Oscillatoria, a fresh water, blue green alga, is represented by 76 species. Species are commonly found in fresh and polluted water of ponds, pools, drains, streams, and also in damp soils and rocks. These form bluish scums on water surface or at pond-bottom.

- O. princeps grows in sea water and sub-aerial habitats. O. brevis can separation bear a temperature of -16°C while O. terebriformis occurs in hot water springs (thermal algae). Some of saprophytic species are found in the digestive and respiratory tracts of the animals.

THALLUS STRUCTURE OF OSCILLATORIA

- It is an un-branched filamentous alga (Fig. 1A). Filaments may be either attached or free floating and rarely occur singly. In majority of the species they form compact tangle mass or spongy sheets. The filaments may be interwoven or arranged in parallel rows. The filaments are uniseriate each containing a single trichome the trichomes are usually naked and have a thin, poorly developed sheath.
- They are usually smooth but sometimes constricted at the cross walls. Each trichome is an un-branched, long, flat thread like structure made up of numerous cells. The cells are broader than in their length and show prokaryotic organization.

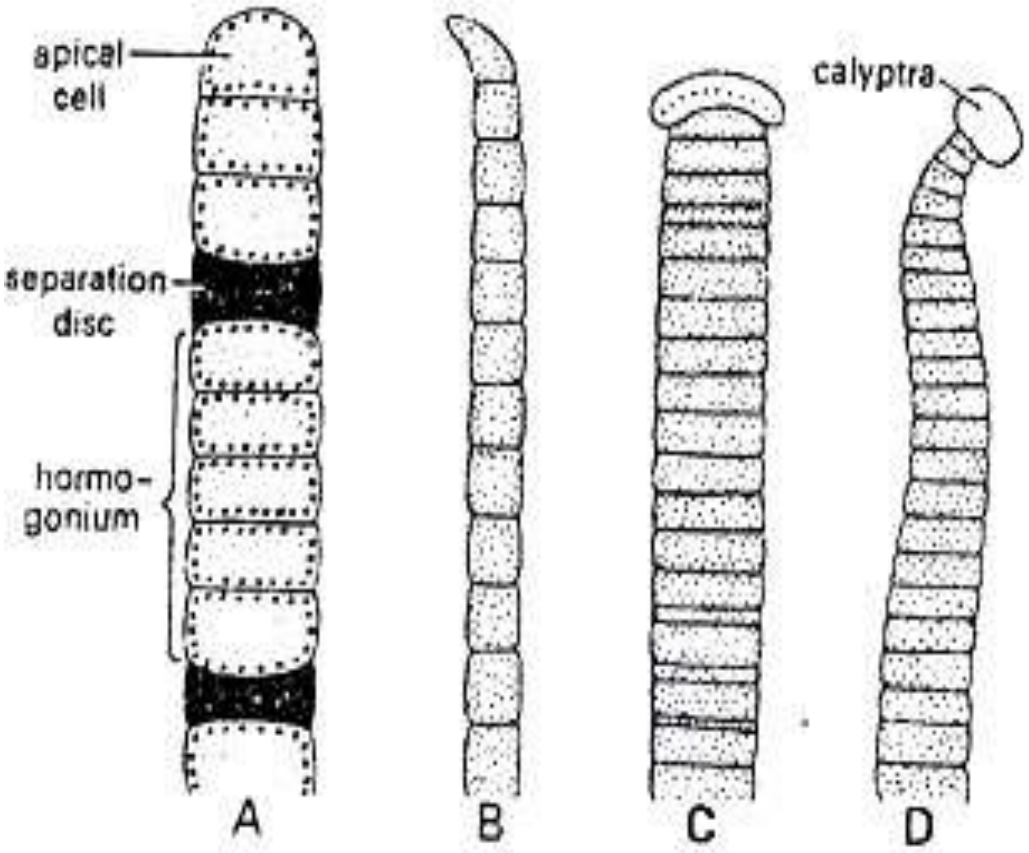


Fig. 1 (A–D) : *Oscillatoria* : Trichomes.

CELL STRUCTURE

- Cell wall is made of mucopeptide. Ultra structurally it consists mainly a 2000 A structural layer external to plasma membrane.
- Under an ordinary microscope the protoplasm is distinguishable into a peripheral chromoplasm and a central colourless centroplasin or central body.
- Ultrastructure of cell shows that the chromoplasm contains photosynthetic lamellae or single thylakoid which often run parallel to one another. The thylakoids contain photosynthetic pigments like chlorophyll a, carotenes, xanthophyll's and phycobilins (C-phycocyanin, allophycocyanin, c-phycoerythrin).
- Phycobilins occur in minute vesicles called phycobilisomes. The centroplasm represents the incipient nucleus called gonophore. It is represented by DNA fibrils. The cell contains many ribosomes but mitochondria, plastids, ER and Golgi bodies are absent.
- Reserve food material is in the form of cyanophycean starch, lipid, globules and cyanophycin. The protoplasm also contains two types of granules α and β α granules contain proteins and polysaccharides.

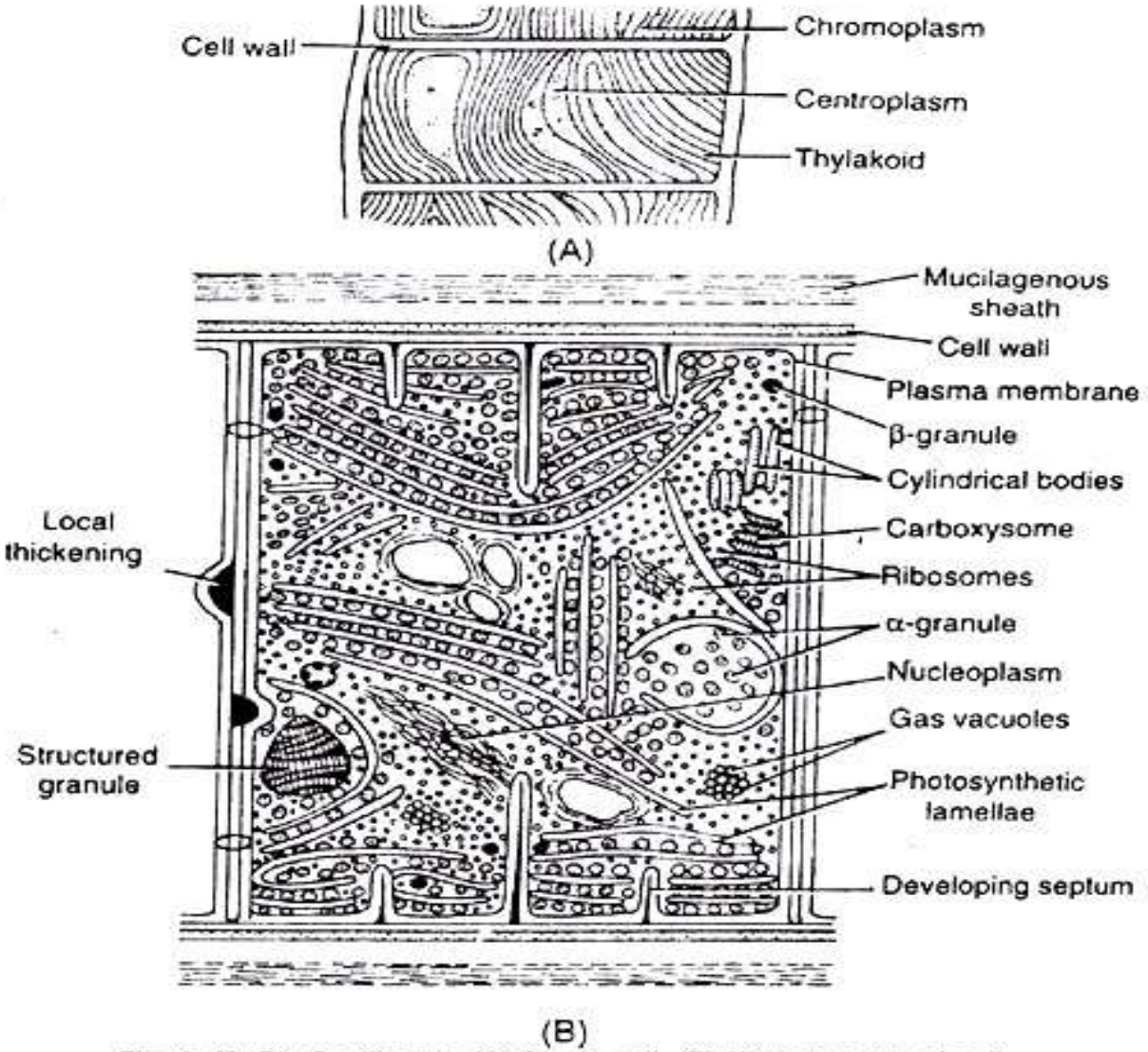
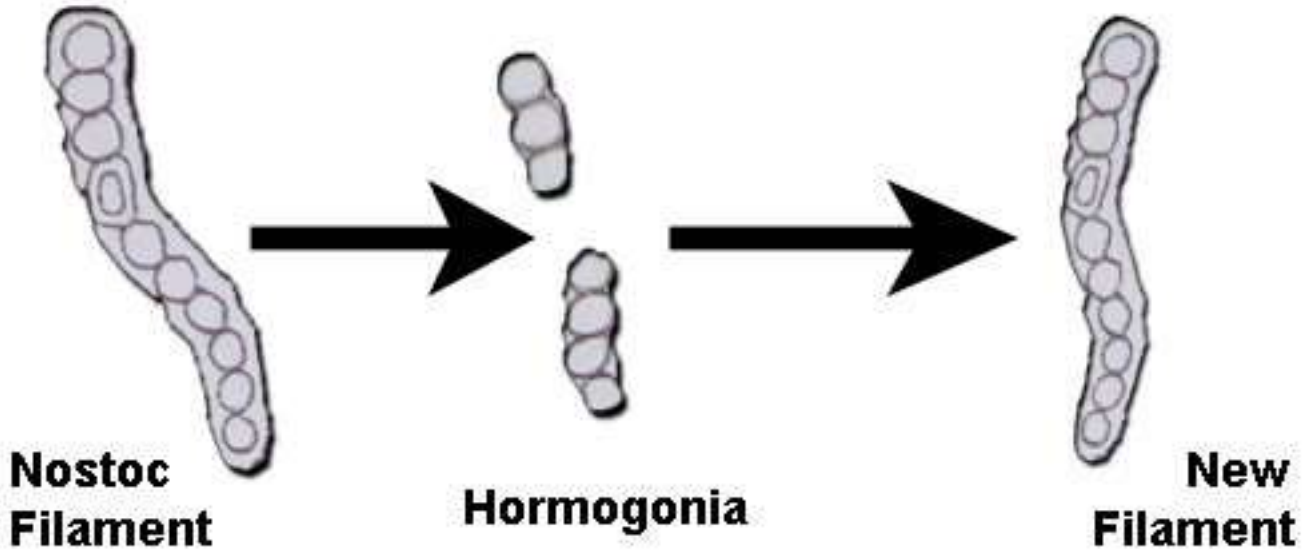


Fig. 2. (A–B). ***Oscillatoria.*** **(A) Single cell, (B) Ultrastructure of cell.**

Reproduction in Oscillatoria

- **1. By fragmentation:**
- It occurs due to accidental breakage of the filament, biting of some .insects or animals. Filament divides into small pieces or fragments. Each of these fragments is capable of developing into new individual.
- **2. By hormorgonia:**
- Hormogonia or hormogones are short segments of trichome which consists few cells. Hormogones are formed due to formation of separation discs. These discs are mucilaginous, pad like and biconcave in shape. These are formed by death of one or more cells of the filament. These mucilage filled dead cells are also called necridia.

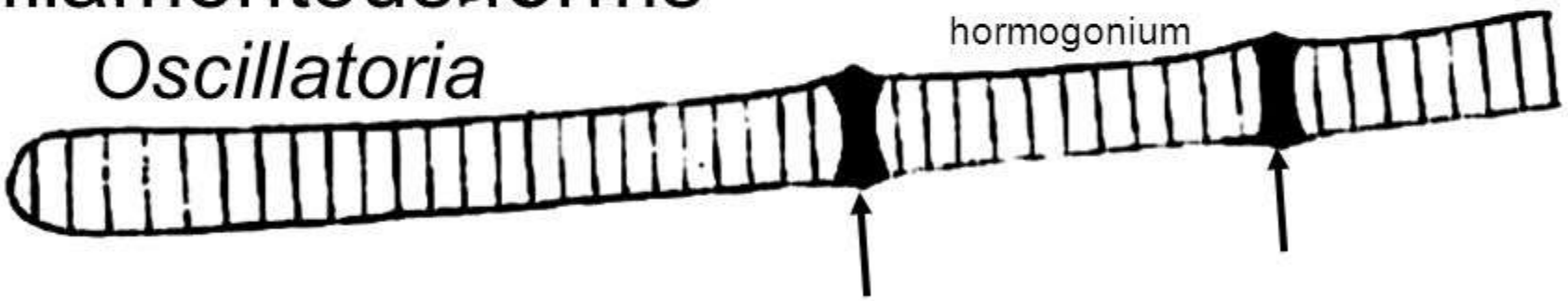

Nostoc
Filament
Hormogonia
New
Filament

Cyanobacteria: systematic characters

Vegetative reproduction:

by hormogonia, only in some filamentous forms

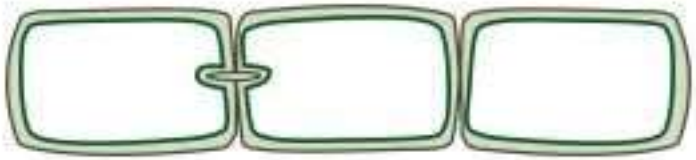
Oscillatoria



"separation discs" (necridia)

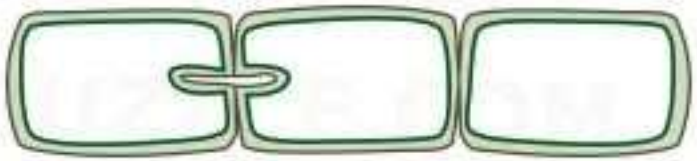
Lyngbya

A Type of Fragmentation



1. The end walls grow inwards

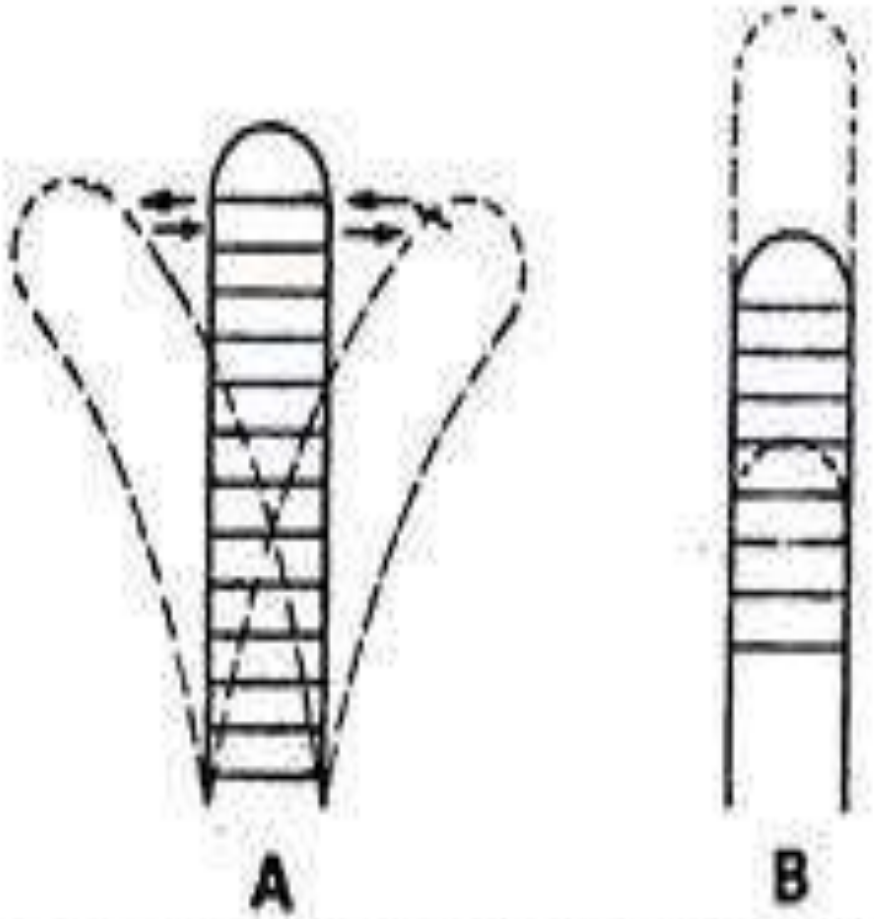
2. The ingrowths enlarge



3. The filament breaks and the fragments separate

MOVEMENT IN OSCILLATORIA

- The name Oscillatoria (oscillare, to swing) is given to this alga due to the peculiar movement shown by the. trichome. It is called **‘oscillatory movement’**. These are the jerky, pendulum-like movements of the apical region of the trichome.
- **Some other movements shown by the trichomes of Oscillatoria are:**
- **Gliding or creeping movement:**
- The trichome moves forward and backward along its long axis.



Oscillatoria. (A). Oscillatory movement; (B) Gliding movement.


Thank
you