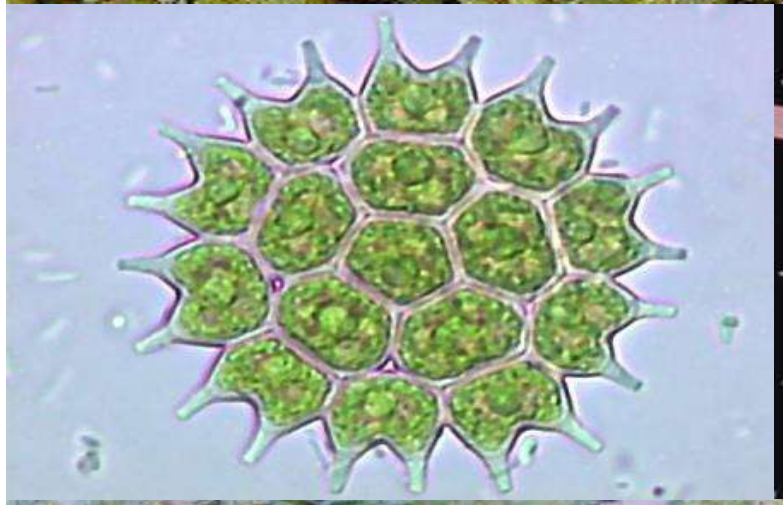
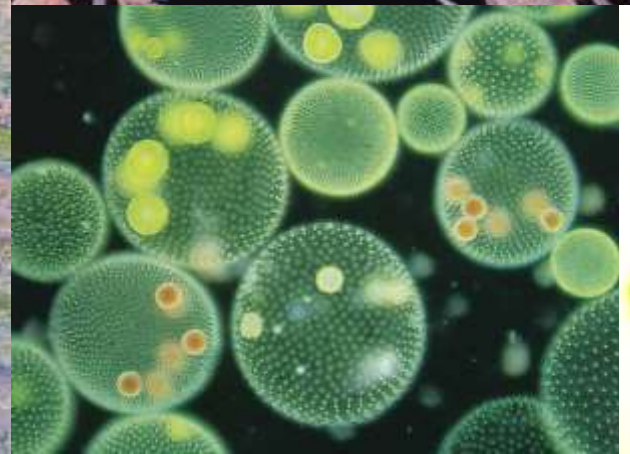
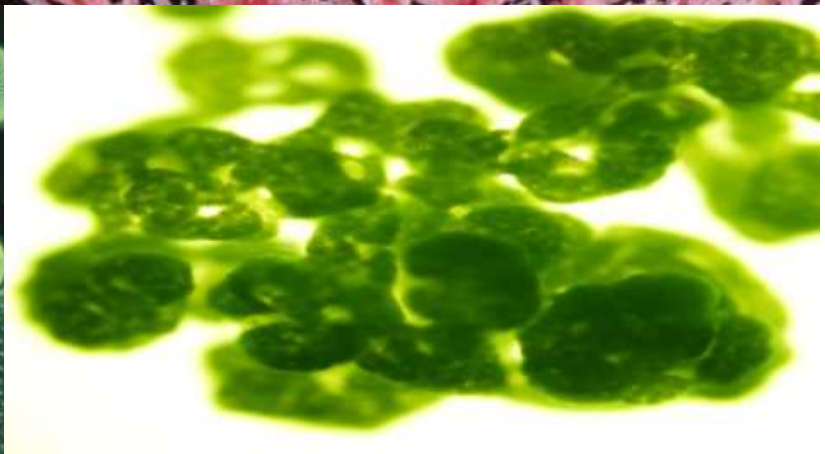


Algae

An Overview





Characteristics

- Autotrophic, contain chlorophyll as their primary photosynthetic pigment
- Range in size from microscopic single celled organisms to large seaweed
- Aquatic and have flagella at some point in life
- Often contain pyrenoids, organelles that synthesis and store starch
- They reproduced by both asexual and sexual forms.
- The reproductive structures – gametangia or gamete chambers
- Absence of a sterile covering of cells around their reproductive cells

The occurrence of Algae

- Algae are present all over the earth, they are present everywhere which means they are **ubiquitous.**
- Algae can be found in freshwater, marine water, on soil, on a rock, as epiphytes or parasites on plants and animals, in hot springs, in the desert, on permanent snow-fields, etc. Most of the algae are found in aquatic environments.

Based on the habitat the algae is classified into different groups such as;

1. Aquatic algae
2. Terrestrial algae
3. Algae of remarkable habitats

1. Aquatic Algae:

•These types of algae can be found in either freshwater or marine. Freshwater has a low salinity of 10 ppm whereas the Marin water has a salinity of 33-40%.

•Freshwater algae can be found in ponds, lakes, tanks, ditches, etc.

•The algae which are suspended on the upper part of freshwater is known as planktonic whereas at the benthic algae are known as bottom-dwellers.

•The neustonic algae are grown at the air-water interface.

Example:

•Freshwater Algae: Chlamydomonas, Volvox, Ulothrix, Chara, Oedogonium, Spirogyra, Nostoc, Oscillatoria, etc.

•Marin water: Sargassum, Laminaria, Ectocarpus, Polysiphonia, Caulerpa, Bangia, Padina, etc.

2. Terrestrial algae

•Terrestrial algae are growing on soils,' rocks, logs, etc.

•Those algae that are growing on the soil surface are called **saprophytes** and those are growing under the soil is known as **cryptophytes.**

•Terrestrial algae are classified into different groups based on the types of habitat such as;

- •Endedaphic: They Inhabitat in soli
- •Epidaphic: They inhabitant on the soil surface
- •Hypolithic: They grow on the lower surface of the stones on the soil
- •Chasmolithic: They grow on rock fissures
- •Rndolithic algae: They penetrate the rock

Example: Oscillatoria Sancta, Vaucheria geminata, Chlorella lichina, Euglena sp., Fritschiella sp., and Phormidium sp.

3. Algae of remarkable habitats

Some algae are grown on uncommon habitat they are included in this group;

- **Halophytic Algae (or Eurhaline)**
  - Halophytic Algae Inhabitat in highly concentrated salt lakes.
  - Example: Chlamydomonas ehrenbergli, Dunaliella and Stephanoptera sp.
- **Symbiotic Algae**
  - These are grown in association with other organisms such as fungi, bryophytes, gymnosperms or angiosperms, etc.
  - When algae grow in association with fungi is known as lichen.
  - Example: Nostoc, Gloeocapsa, Rivularia; the members of Cyanophyceae and Chlorella, Cytococcus, Pleurococcus; the members of Chlorophyceae.
- **Cryophytic Algae**
  - Cryophytic Algae Inhabitat on ice or snow and are responsible for attractive colors to snow-covered mountains.
  - Example: Haemotococcous nivalis is responsible for the red color on alpine and arctic mountains, Chlamydomonas yellowstonensis responsible for green snow in Europe, Scotiella nivalis and Raphidonema brevirostri responsible for black colouration of snow, whereas Ancyclonema nordenskioldii generate brownish purple colouration

- **Thermophytes or Thermal Algae**
  - Thermophytes or Thermal Algae grow in hot water springs where the temperature is around 50- 70°C.
  - Example: blue-greens such as Oscillatoria brevis, Synechococcus elongates, Heterohormogonium sp. are grown in such hot springs.
- **Lithophytes**
  - Lithophytes Inhabitat on the moist surface of stones and rocks.
  - Example: Nostoc,. Gloeocapsa, Enteromofpha, Batrachospermum etc.
- **Epiphytic Algae**

Epiphytic Algae Inhabitat on other plants including other algal members such as;

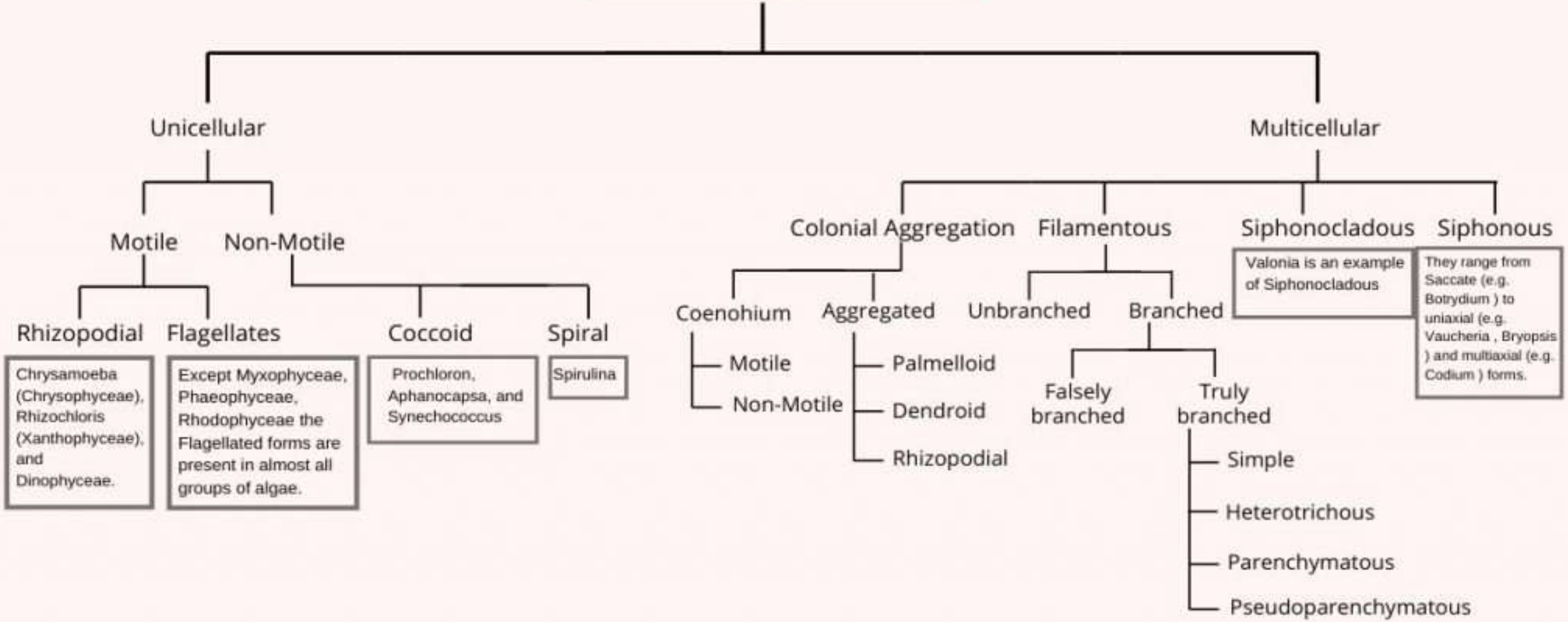
- Algae on Algae
  - Ptilota plumosa and Rhodymenia pseudopalmatta grow on Laminaria hyperborean
  - Diatoms grow on Oedogonium, Spirogyra etc.
- Algae on Angiosperms
  - Cocconis, Achnanthes etc. grow epiphytically on Lemna.
  - Trentepohlia grows on the barks of different angiosperms plants
- Algae on Bryophytes
  - Nostoc, Oscillatoria, diatoms Inhabitat on different bryophytes.

- **Epizoic Algae**
  - Epizoic Algae Inhabitat on animals like fish, snail etc.
  - Example: Stigeoclonium are grow in the gills of fishes.
- **Endozoic Algae**
  - Endozoic Algae Inhabitat within the animal tissues.
  - Example: Zoochlorella sp. is grown in Hydra viridis.
- **Parasitic Algae**
  - Parasitic Algae are grown parasitically on various plants and animals.
  - Example: Cephaleuros (Chlorophyceae) Inhabitat on leaves of tea (Camellia sinensis), coffee (Coffea arabica), Rhododendron, Magnolia and pepper (Piper nigrum), Rhodochytrium (Chlorophyceae) Inhabitat on ragweed (Ambrosia) leaves, Phyllosiphon (Chlorophyceae) Inhabitat on the leaves of Arisarum vulgare, Ceratocolax (Rhodophyceae) Inhabitat in Phyllophora thallus.
- **Psammon**
  - They are mainly Inhabitat on sandy beaches.
  - Example: Vaucheria, Phormidium etc.

Thallus Organization in Algae

- Algal thallus ranges from unicellular to multicellular form and size ranges from a few microns to some meters.
- The smallest unicellular algae is *Micromonas pusilla* which is 1 μm (0.00004 in.) in size and the giant kelps contain the longest thalli that reaches up to 60 m (200 ft) in length.
- The algal unicellular forms remain solitary as a single unit that is capable of completing their life cycle with the help of all physiological, biochemical, genetic requirements and may be motile or non-motile.
- The unicellular form constitutes a colonial structure when held together in a common gelatinous matrix, this is known as the intermediate stage of unicellular and multicellular structures.
- There are present various intermediate stages in thallus organization such as palmella, dendroid, palmelloid, coccoid, filamentous, siphonaceous, heterotrichous, uniaxial, multiaxial etc.

Thallus Organisation in Algae



1. Unicellular

•These algae are also known as the acellular algae

•Unicellular algae can be motile or non-motile.

A. Motile form of Unicellular Algae

The motile form of unicellular algae can move from one place to another place.

•Rhizopodial:

- They lack a rigid cell wall and contain a naked protoplast.
- Their cell envelope is periplasmic and soft which permits extensive changes in the shape and size of the thallus.
- Instead of flagella, they contain cytoplasmic projections known as Pseudopodia and Rhizopoda and follow the Ameboid movement for their locomotions.
- Examples: *Chrysamoeba (Chrysophyceae)*, *Rhizochloris (Xanthophyceae), and Dinophyceae.*

•Flagellates

- These are looks like motile gametes and zoospores
- They are spherical, elongate, ovoid or round in cross-section.
- They contain one or two or many, equal or unequal, and tinsel or whiplash-type flagella.
- Examples: Except *Myxophyceae*, *Phaeophyceae*, *Rhodophyceae* the Flagellated forms are present in almost all groups of algae.

B. Non Motile form of Unicellular Algae

The Non Motile form of Unicellular Algae can not move from one place to another place. Non Motile form of Unicellular Algae are divided into two groups such as;

- **Coccoid**

  They are unicellular.

  Coccoid has a rigid cell wall and are non-flagellated

  They lack motility but they can motile during the reproductive stages.

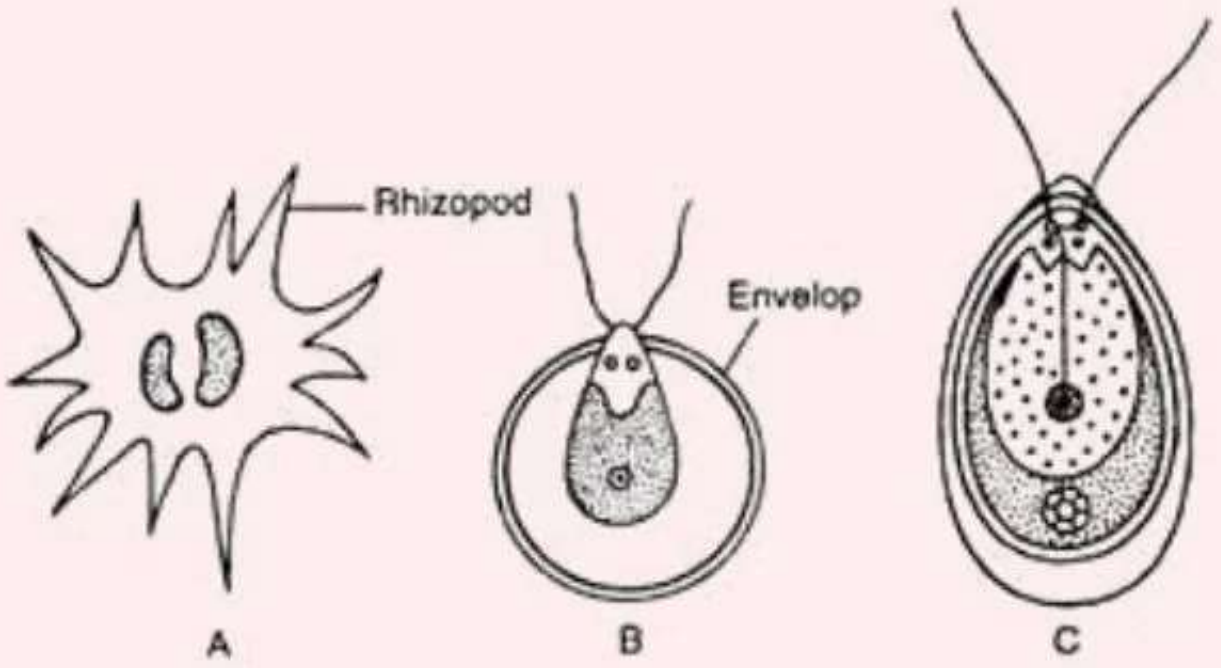
  Most of them are belonging to algal classes and predominate in Xanthophyceae (70 %).

  Example: *Prochloron, Aphanocapsa, and Synechococcus*

- **Spiral**

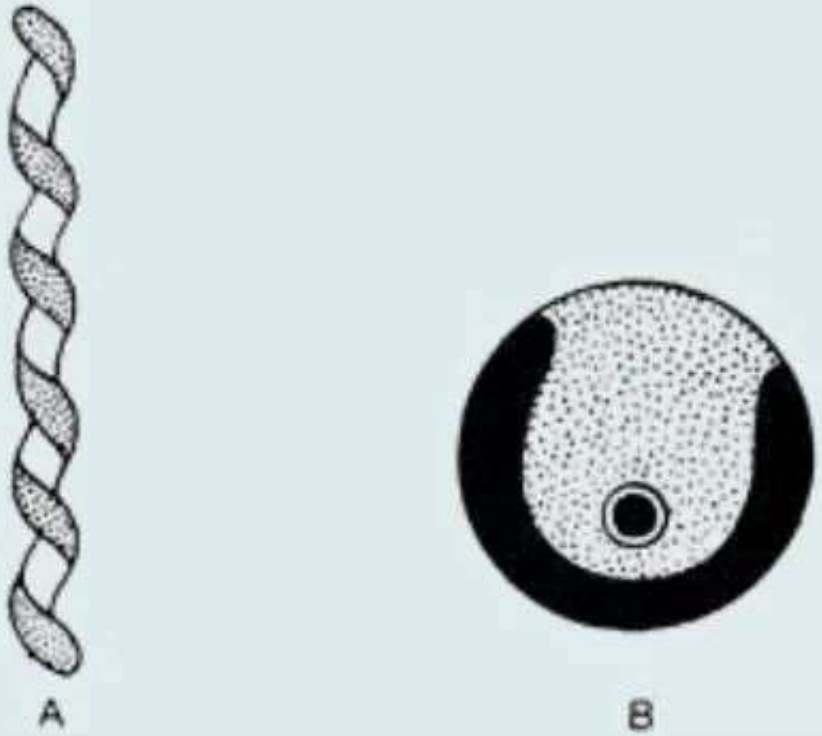
  They are unicellular with spiral filament.

  Example: *Spirulina*



Unicellular Motile Algae

A. *Chrysamoeba,* B. *Phacotus,*
C. *Chlamydomonas*



Unicellular non-Motile Algae

A. *Spirulina,* B. *Chlorella*

2. Multicellular Forms

Different types of unicellular algae aggregate and formed multicellular algae.

A. Colonial Aggregation

•When the unicellular form of algae loosely aggregates within a common mucilaginous investment they are called Colonial Aggregation.

•A cytoplasmic thread connects each cell within this aggregation.

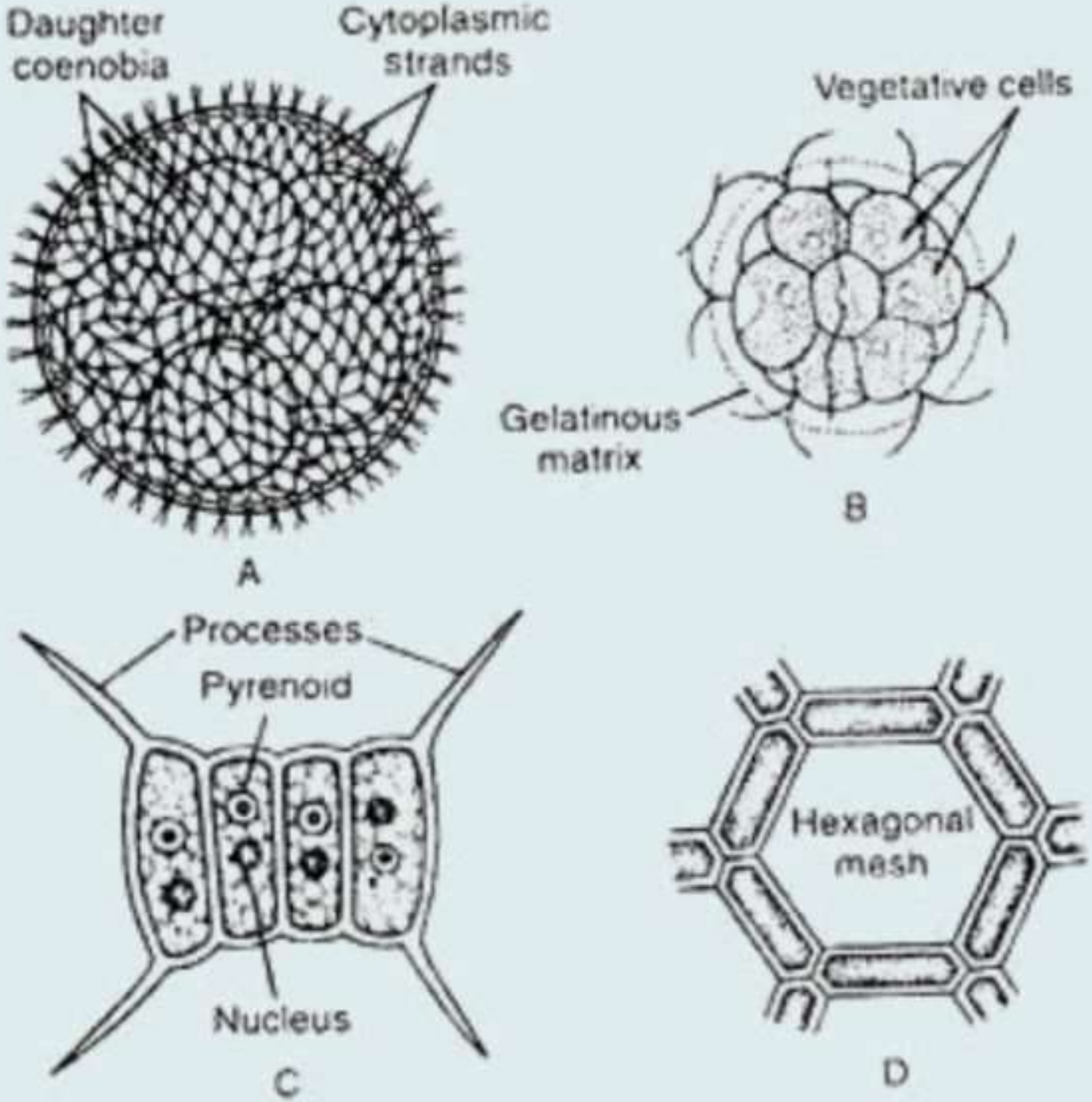
•Colonial Aggregation divided into two classes such as –

(i). Coenobium

•The coenobium colony contains a definite number of cells with a definite shape and arrangement.

•Coenobium colony is divided into two different groups such as;

- **Motile:** They are cellular and flagellated and can move by an organised beating action of flagella. Example: *Volvox*, *Pandorina*, *Eudorina etc.*
- **Non-Motile:** They lack flagella hence they are no-motile. Example: *Scenedesmus*, *Hydro- dictyon.*



Colonial Algae

A. *Volvox*
B. *Panorina*
C. *Scenedesmus*
D. *Hydrodictyon*

(ii). Aggregated Forms

•Aggregated forms of algae are aggregated irregularly and show a colonial mass of various sizes and shapes.

•The Aggregated Forms of algae is divided into three groups such as;

(a). Palmelloid:

•In palmelloid all the non-motile cells remain embedded within an amorphous gelatinous or mucilaginous matrix.

•All the cells present in the palmelloid are independent and perform their functions individually.

•Example: *Tetraspora and Palmodictyon (Chlorophyceae), Gleochloris and Chlorosaccus (Xanthophyceae), Phaeocystis (Chrysophyceae) and Microcystis (Cyanophyceae)*

(b). Dendroid:

•In Dendroid the cells are variable in number, shape, and size.

•They resemble microscopic trees.

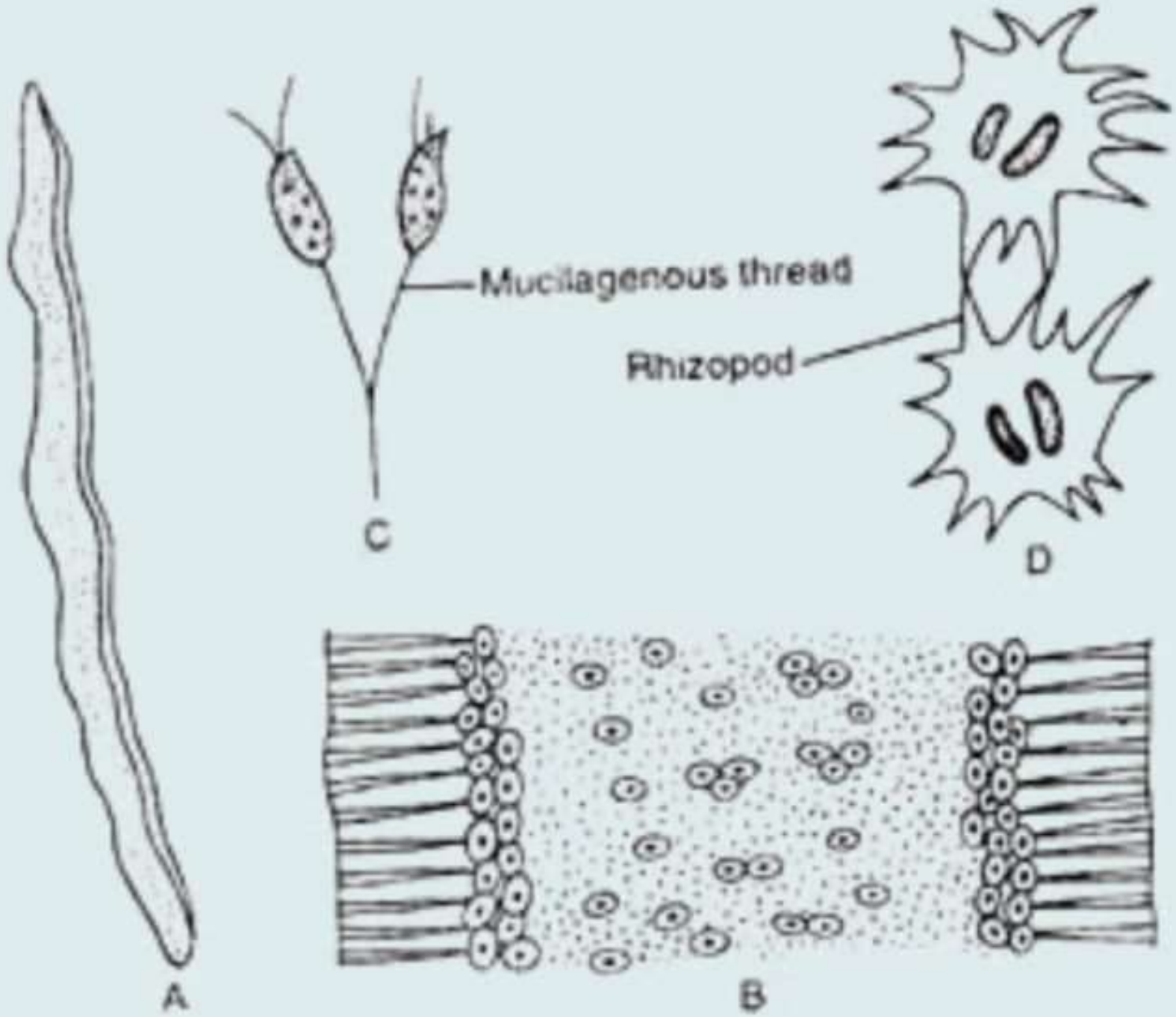
•They show polarity due to the presence of a mucilaginous thread at the base of each cell.

•Example: *Prasinocladus*, *Ecballocystis*, *Chrysodendron*

(c). Rhizopodial:

•The cells are united by rhizopodia.

•Example: *Chrysidiastrum*



Aggregated form

A. *Tetraspora*
B. *Tetraspora*
C. *Chrysodendron*
D. *Chryidiastrum*

B. Filamentous Forms

When cells are divided repeatedly in a single plane and in a single direction they form a filamentous plant body. In this type, the cells are firmly attached to each other — end to end forming a chain or a thread-like structure.

Filamentous Form is two types such as;

(i). Unbranched Filament

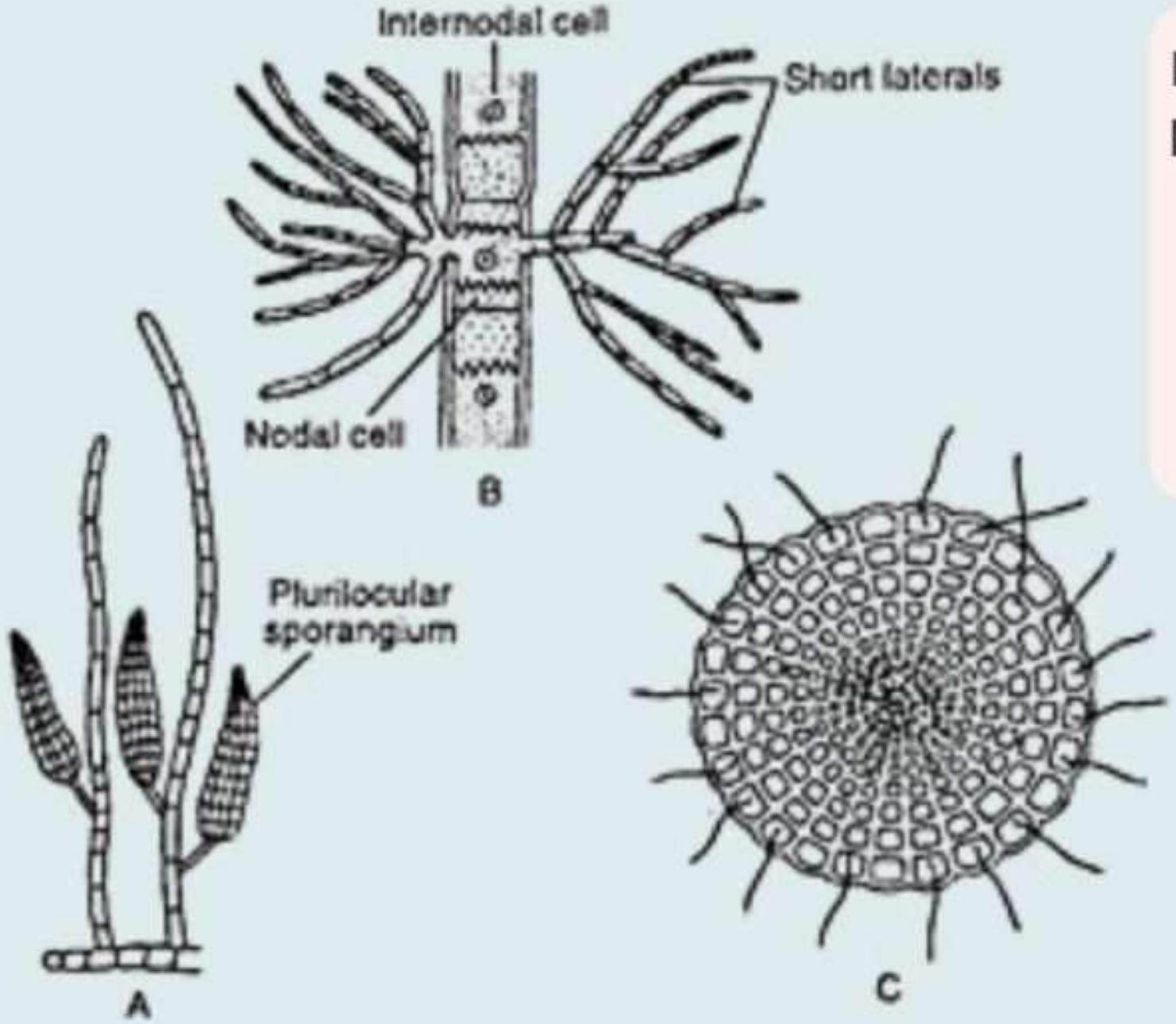
•They are free-floating or attached to the substratum.

•In the case of Unbranched filaments which remain attached to the substratum are differentiated into base and apex whereas the free-floating one is not differentiated into basal and apical ends.

•Example: *free-floating (e.g., Spirogyra), attached to the substratum (e.g., Ulothrix, Oedogonium, etc.).*

(ii). Branched Filament

•When a filament occasionally starts division in a second plane they form a Branched Filament.



Branched Filament Showing heterotrichous habit:

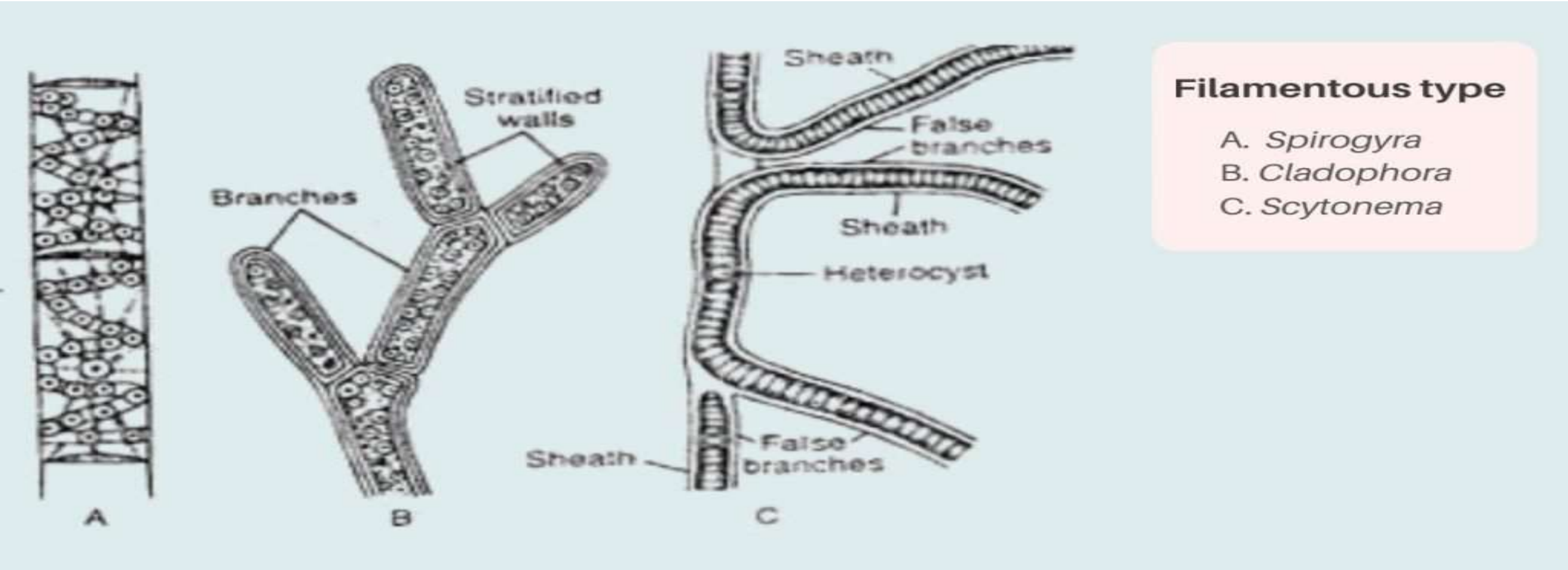
A. *Ectocarpus*
B. *Draparnaldiopsis*
C. *Coleochaete*

•Branched Filament is two type such as;

(a). Falsely branched

•The trichome is generally fragmented due to the degeneration of an intercalary cell (or by the formation of biconcave separation discs) after which one or both of its ends adjacent to the dead cell grows out of the parent sheath, giving the resemblance of branching.

•Example: *Scytonema*



(b). Truly branched

•True branching occurs when repeated transverse divisions of the lateral outgrowths produced by a few or many scattered cells of the main filament.

•The truly branched thalli are of four types:

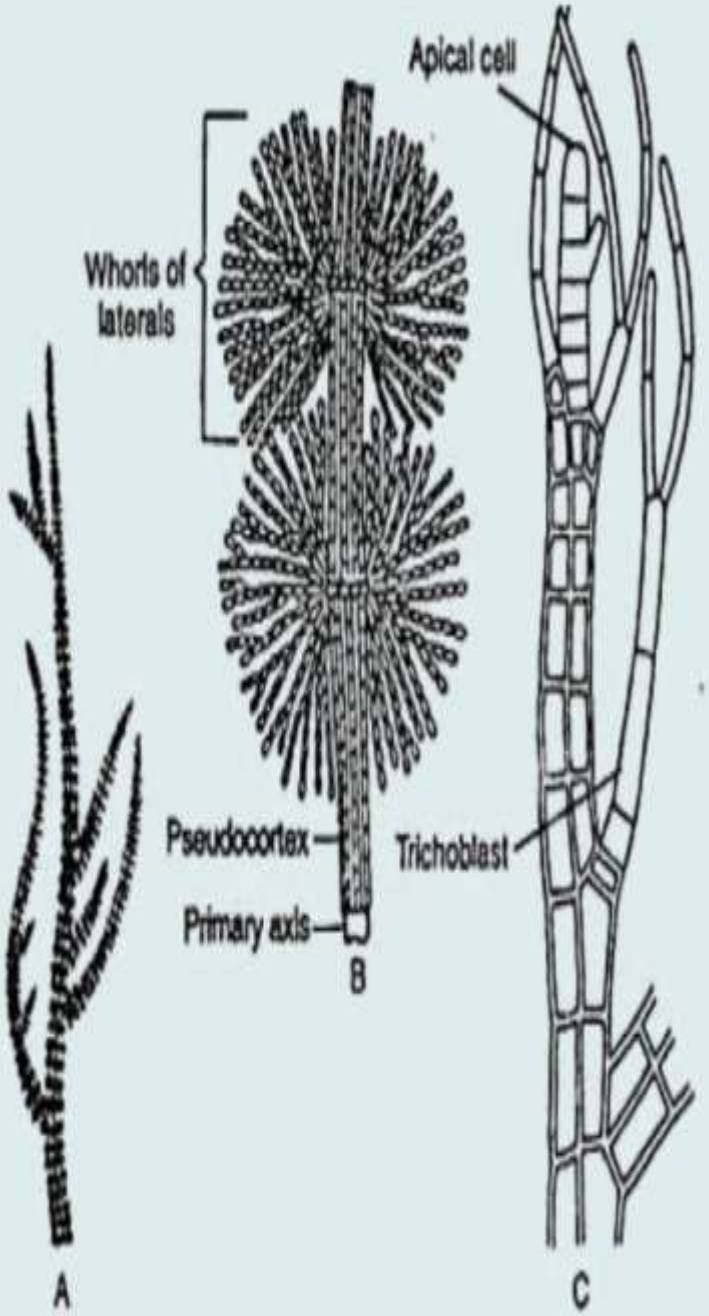
- **Simple Filament:** In Simple Filament, the whole thallus is attached to the substratum with the help of a basal cell and the branches may emerge from any cell of the filament except the basal cell. Example: *Cladophora.*
- **Heterotrichous Habit:** In Heterotrichous Habit, the whole thallus is divided into a well-developed prostrate and erect system. Example: *Fritschiella*, *Ectocarpus*, *Draparnaldiopsis*, *Stigoclonium.*
- **Parenchymatous forms:** This occurs when cells of the primary filament divide in all directions, any essentially filamentous structure is thus lost early. Example: *Porphyra* , *Ulva* , *Enteromorpha.*
- **Pseudoparenchymatous Habit:** The Pseudoparenchymatous is formed when one or more central or axial filaments get together with their branch fuses and develop a parenchymatous structure. Example: *Batrachospermum*, *Polysiphonia.*

Parenchymatous Algae

A. Ulva

B. Sargassum

C. Laminaria



Pseudoparenchymatous

A. Batrachospermum

B. Batrachospermum

(Portion of the plant body)

C. Polsiphonia

C. Siphonocladous Organization

•This is restricted to members of Chlorophyceae.

•In this type the unbranched (Urospora, Chaetomorpha) or branched (Acrosiphonia, Cladophora) filaments are composed of multinucleate (semi – coenocytic) cells.

•*Valonia* is an example of Siphonocladous which is a spherical vesicle up to 10 cm in diameter and has been described as the largest plant cell.

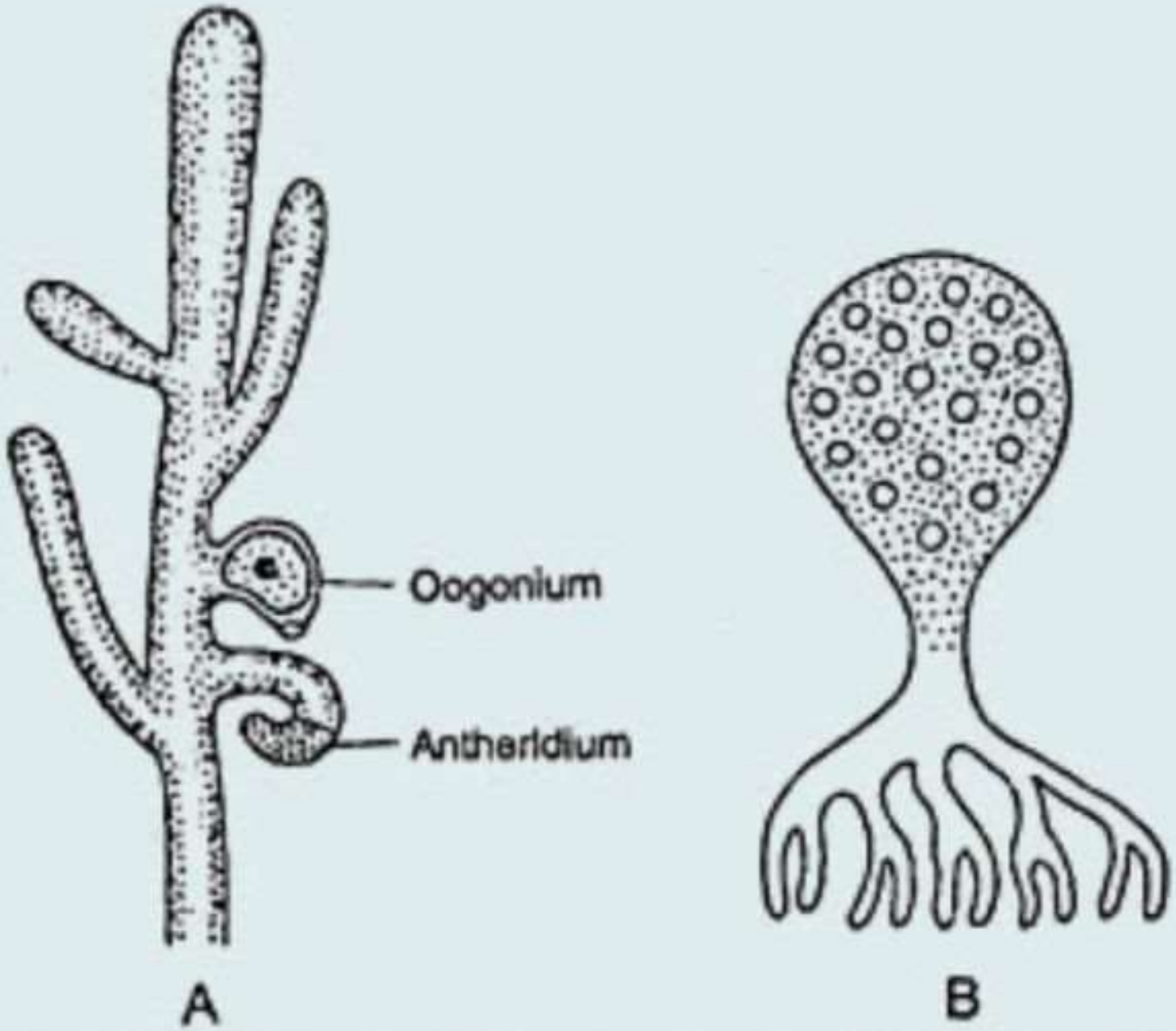
D. Siphonous Organization

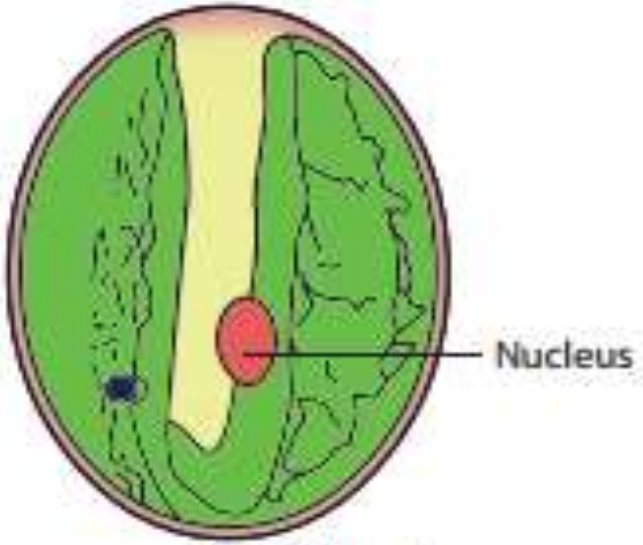
•Few marine Chlorophyceae (order Siphonales, Bryopsidales,Dasycladales) and some Xanthophyceae (Botrydium , Vaucheria) enlarged and elaborate their thallus in absence of septa. The Nuclear divisions do not follow the cytokinesis (free nuclear division) and which results in a coenocytic, multinucleate thallus and a saphenous organization.

•They range from Saccate (e.g. *Botrydium*) to uniaxial (e.g. *Vaucheria* , *Bryopsis*) and multiaxial (e.g. *Codium*) forms.

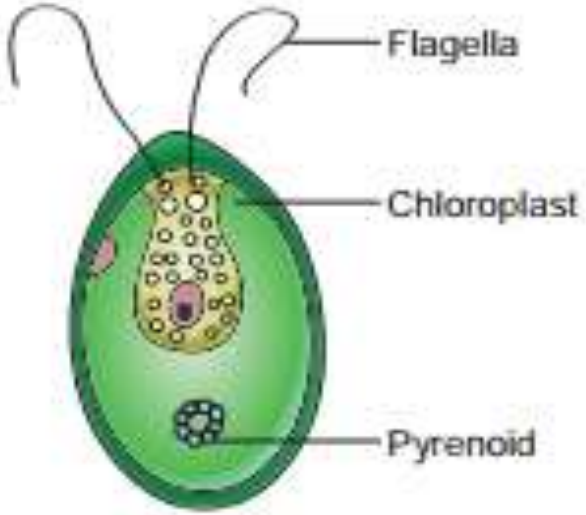
Siphoaxeous algae

A. *Vaucheria*
B. *Botrydium*

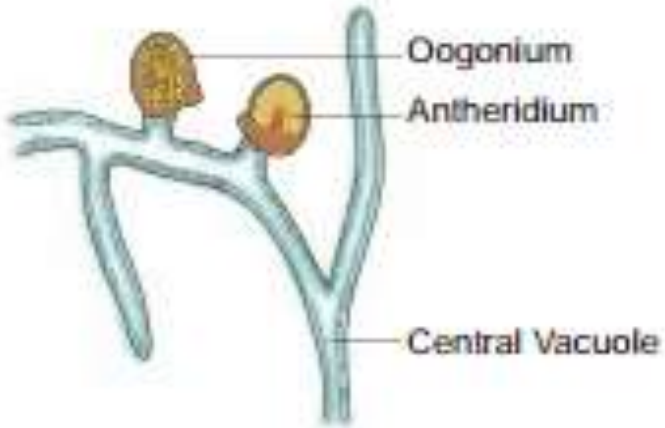




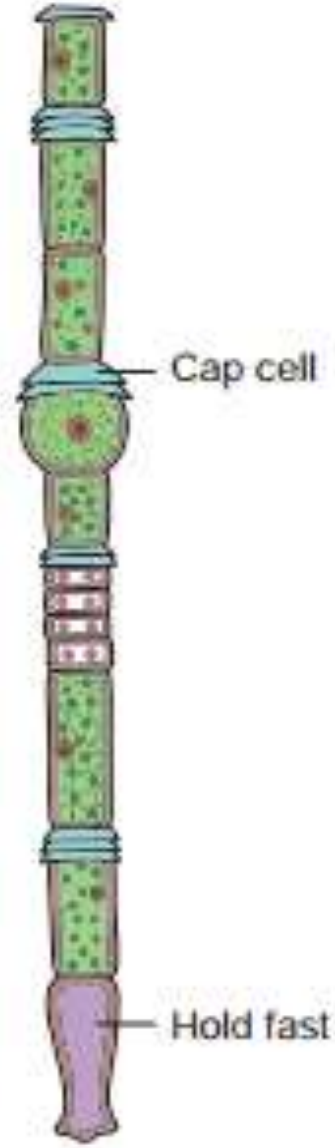
a) *Chlorella*



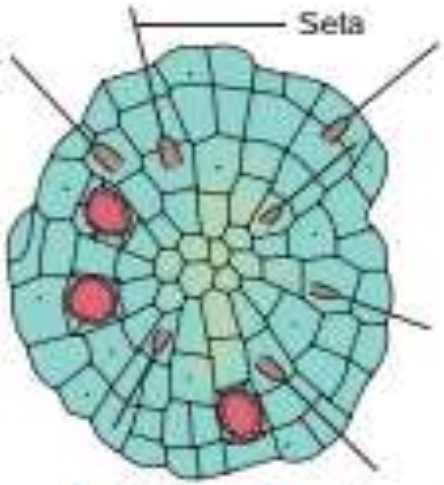
b) *Chlamydomonas*



c) *Vaucheria*



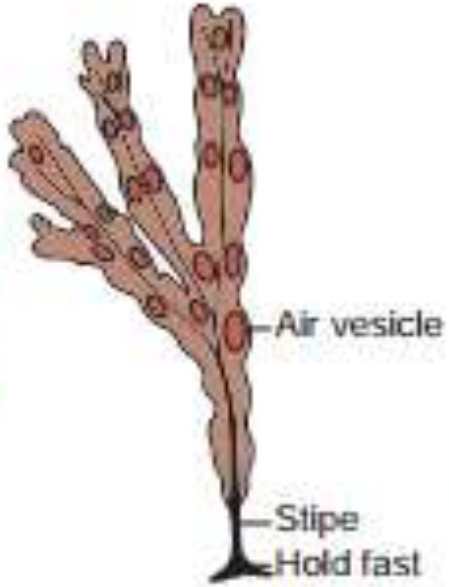
d) *Oedogonium*



e) *Coleochaete*

f) *Fritschiella*

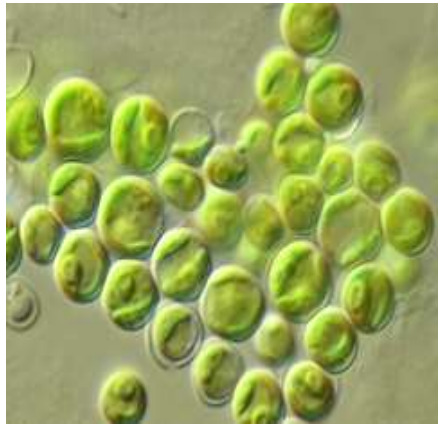
g) *Ulva*



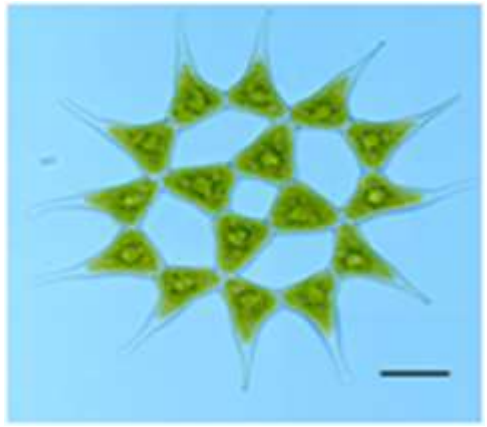
h) *Fucus*

i) *Sargassum*

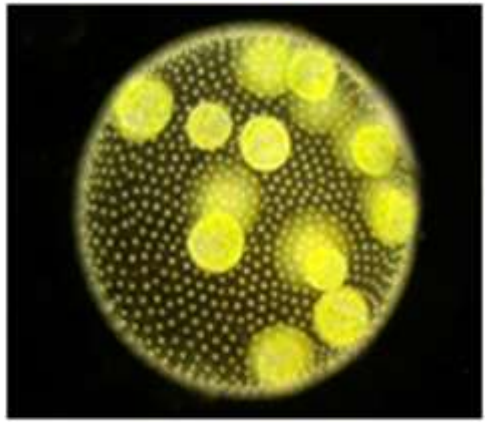
Thallus organization in Algae



Chlorella



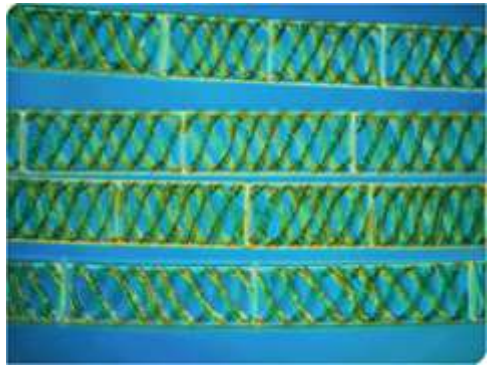
Pediastrum



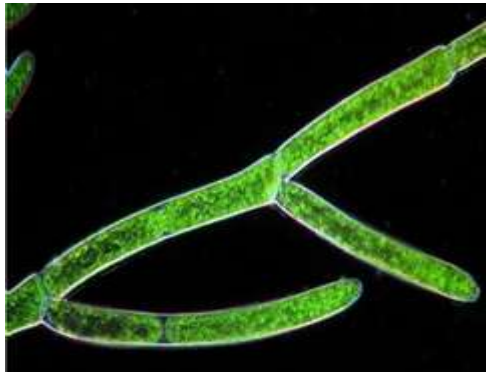
Volvox

Tetraspora

Dinobryon



Spirogyra



Cladophora

Draparnaldiopsis

Vaucheria

Ulva

Let’s revise

Q.1 Describe in detail the range of thallus structure found in algae.

Q.2 What is a coenobium? Give an example of motile and non motile coenobium.

Q.3 What do you understand by heterotrichous habit?

Q.4 Describe the thallus structure of Chara.

Q.5 What is pseudobranching? Explain with example.