
Oedogonium

Classification

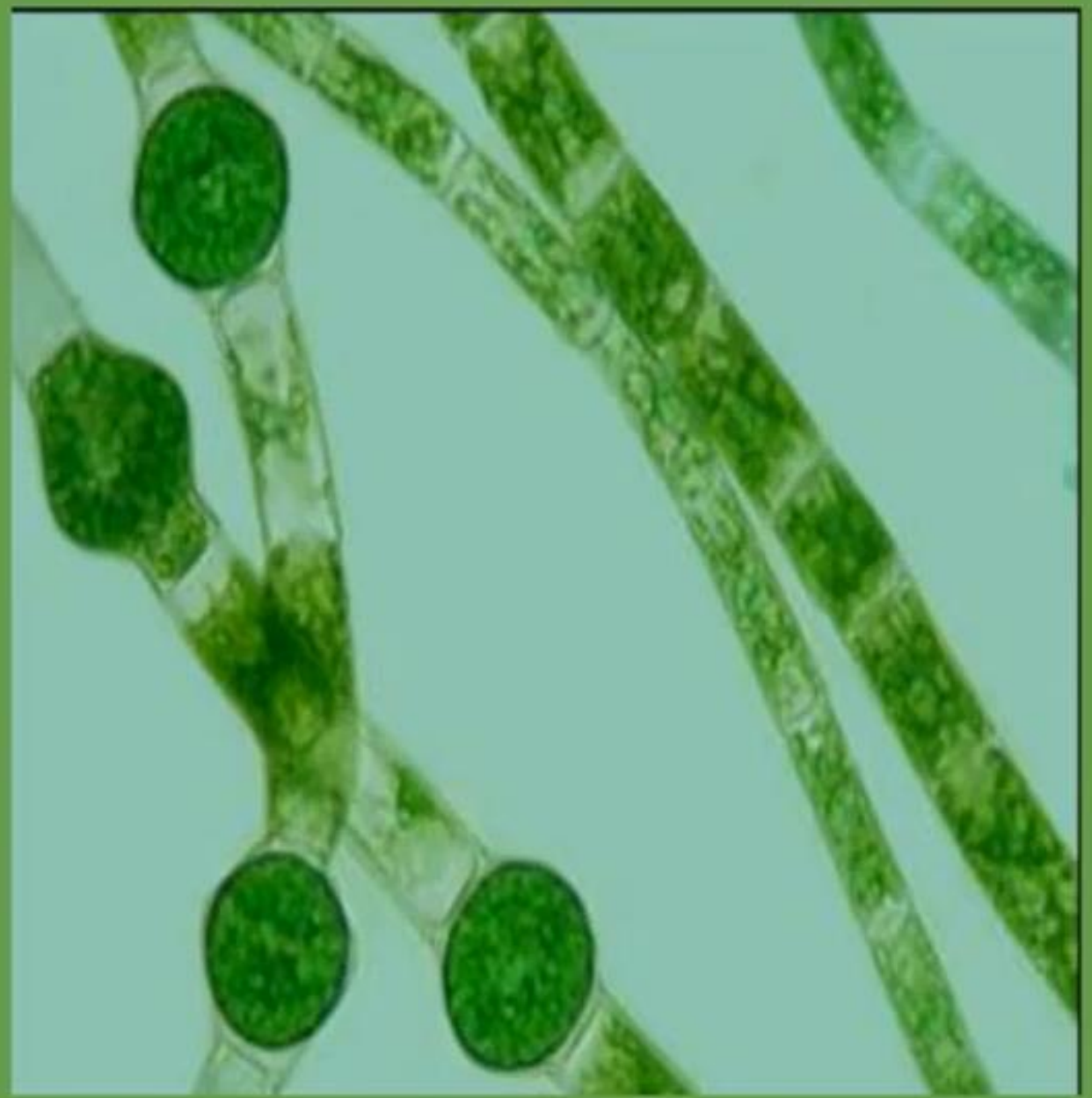
Division **Chlorophyta**

Class **Chlorophyceae**

Order **Oedogoniales**

Family **Oedogoniaceae**

Genus ***Oedogonium***



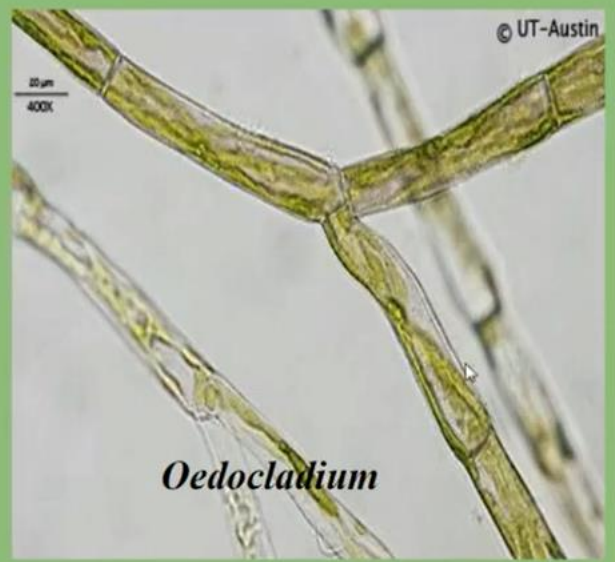
Oedogoniales

- Exclusively fresh water alga.
- Grow in quiet and slow running water.
- Some species like *O. terrestris* are terrestrial.
- It grow epiphytically .
- Thallus is branched (*Oedocladium* and *Bulbochaete*) or Unbranched (*Oedogonium*)
- Filaments are attached to the substratum by their basal cell called holdfast.
- Cells are Eukaryotic, uninucleate and cylindrical.
- Nucleus is parietal.

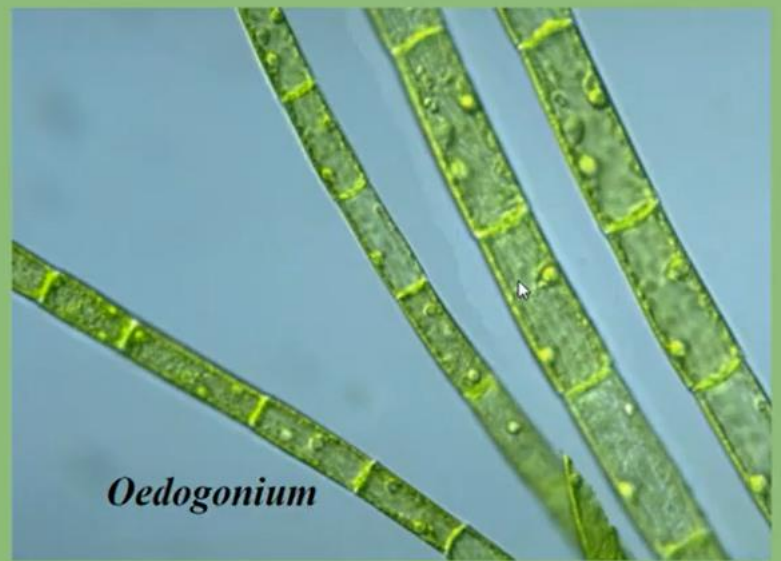
- Cells exhibit apical and basal polarity as they are broader at anterior end.
- Chloroplast is parietal with pyrenoids.
- Cell division is unique ,by splitting of lateral walls of cell .
- Asexual reproduction by zoospores.
- Zoospores are with ring of flagella at anterior part (Multiflagellate).
- Sexual reproduction is advance oogamous.
- Some sps. produce dwarf filaments.
- This order comprises single family *Oedogoniaceae.*

Oedogoniaceae

- Oedogoniaceae family have only three genera.
- *Oedocladium, Oedogonium* and *Bulbochaete*.
- *Oedocladium* is terrestrial and have heterotrichous thallus.
- *Oedogonium* and *Bulbochaete* are aquatic.
- *Oedocladium* and *Bulbochaete* have branched thallus while in *Oedogonium* it is unbranched.


© UT-Austin
10 µm
400X
Oedocladium


Bulbochaete


Oedogonium

Occurrence of Oedogonium

- Oedogonium (Gr. oedos, swelling; gonos, reproductive bodies) is common, submerged and exclusively fresh water alga, found in slow running or quiet water.
- Out of about 400 species more than 200 have been reported from India.
- It grow epiphytically on the aquatic plants in fresh water pools, ponds, lakes etc.
- The mature filaments are free floating but younger ones are attached on the stone, wood, leaves of aquatic angiosperm and large algal plants, small branches of dead plant remain in water etc. by their basal cell the holdfast..
- Some species like *O. terrestris* are terrestrial.
- Common indian sps. are *O. cardiacum, O. aster; O. elegans, O. aerolatum* and *O. armigerum.*

Thallus

- The thallus is green, multicellular and filamentous.
- Filaments form yellow-green mats.
- The filaments are long and unbranched .
- Cells of each filament are attached end to end and form uniseriate row.
- The filament is differentiated into 3 types of cells:

1. Basal cell or rhizoidal cell
2. Apical cell
3. Middle cells.

1. Basal Cell

- It is the lowermost cell of the filament.
- The cell is long, gradually narrowed and towards the basal end it expands to form simple, disc-like, multilobed or finger-shaped structure.
- The cell is generally colourless and called holdfast.
- The function of the basal cell is to attach the filament to the substratum.

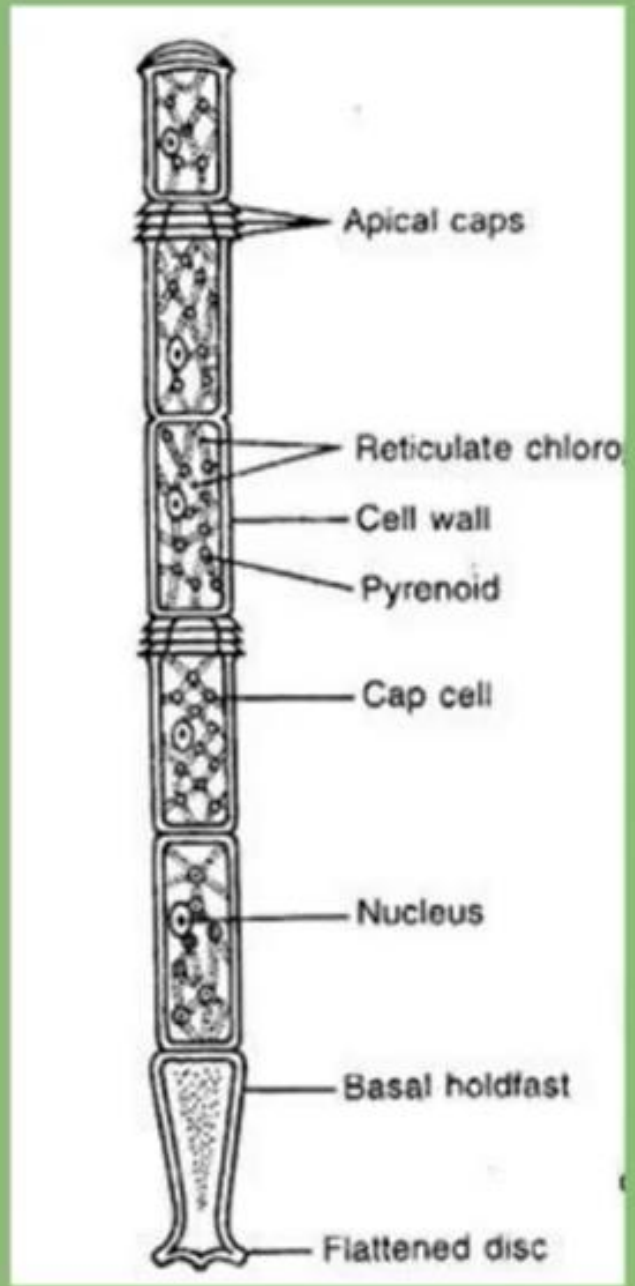
2. Apical Cell

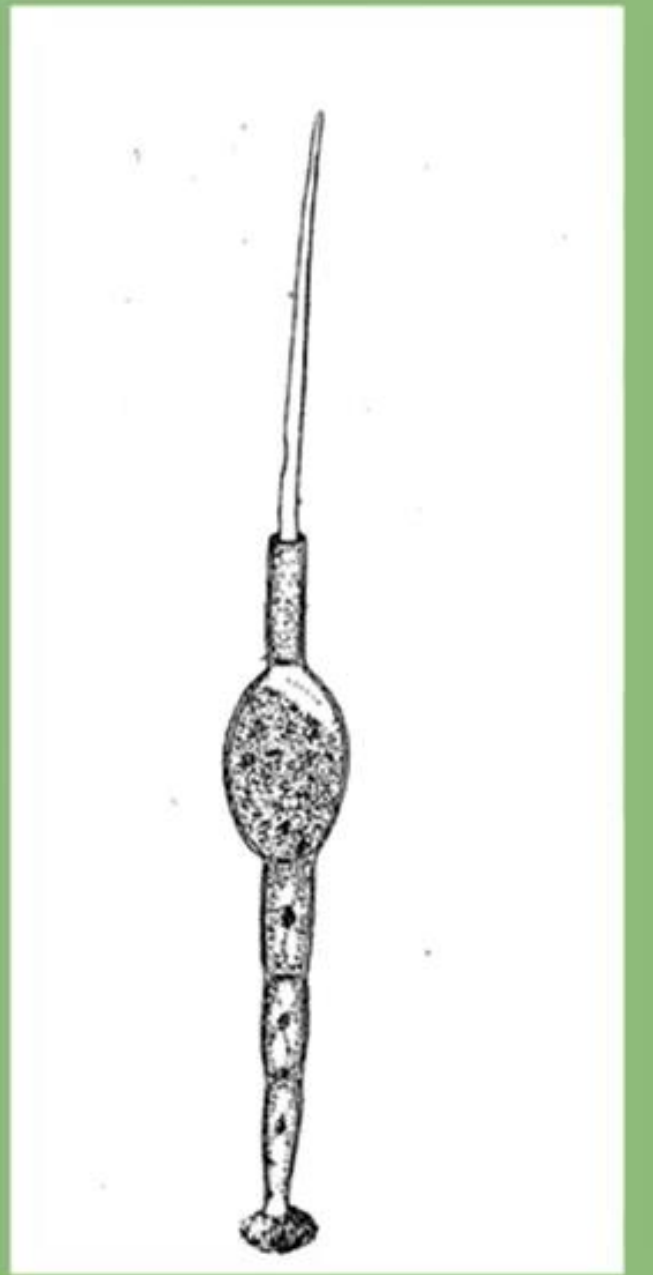
- It is the top most cell of the filament.
- The cell may be broadly rounded or acuminate and green in colour.
- In few sps. it ends in fine, slender and hair like structure. (O. ciliata)

3. Middle Cells

- All the cells in between basal and apical cells are same.
- The cells are rectangular in shape i.e., longer than their breadth .
- Certain cells in a filament have a transverse band-like structure at their distal ends which are known as apical cap.
- The cells with apical cap is called cap cells.
- Cap is made up of hemicellulose.
- The number of caps on a cell indicates the number of cell divisions in that cell.


apical cap


Apical caps
Reticulate chloro
Cell wall
Pyrenoid
Cap cell
Nucleus
Basal holdfast
Flattened disc

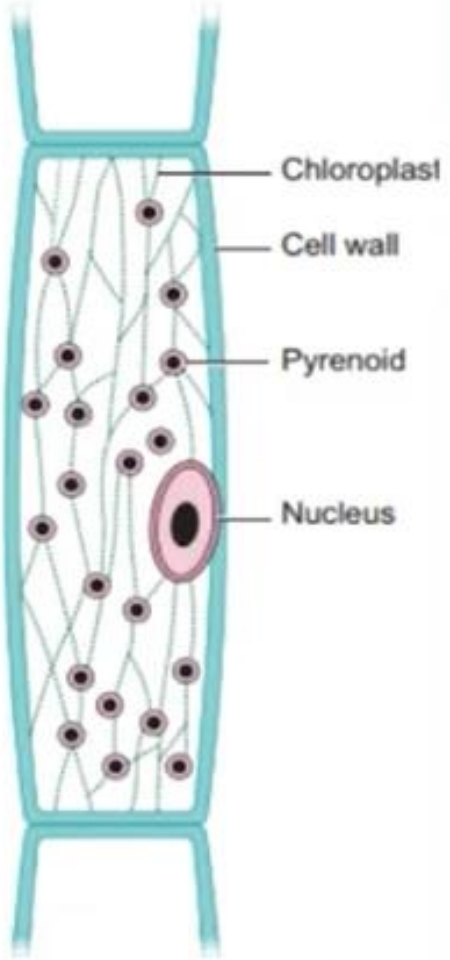


Cell Structure of Oedogonium:

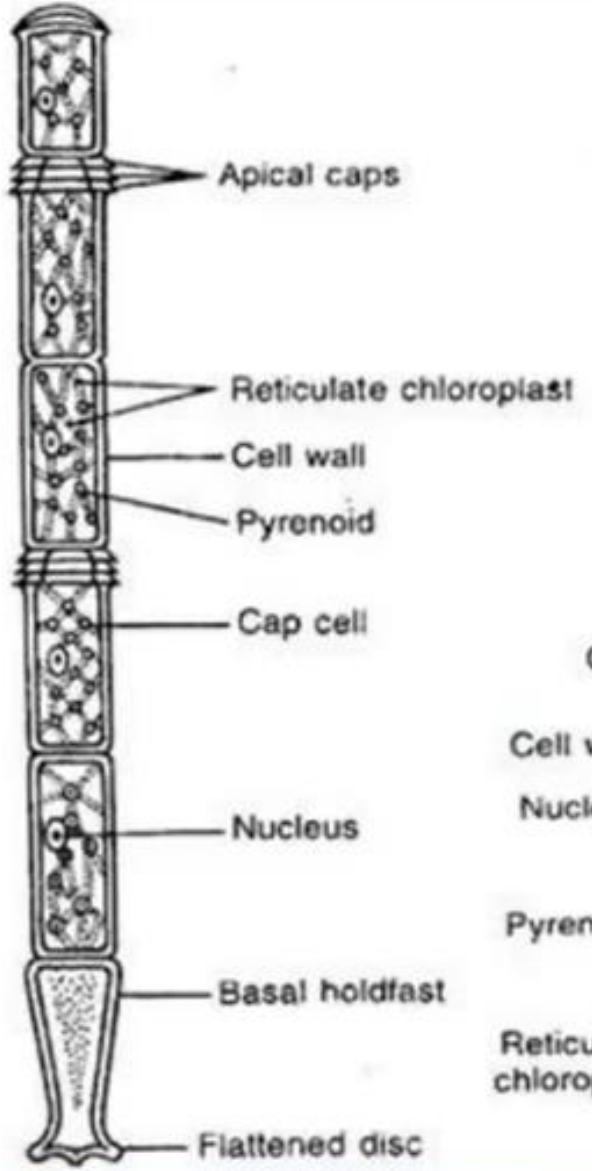
- Cells are eukaryotic.
- The intercalary cells are longer than their breadth and are cylindrical in outline.
- The cells are surrounded by thick and rigid cell wall .
- The cell wall is differentiated into three layers an outer chitin, middle pectin and innermost cellulosic.
- Chitin layer prevents dissolving away of the pectic substances.
- So filaments feel like wet thread.
- Mucilage is absent.

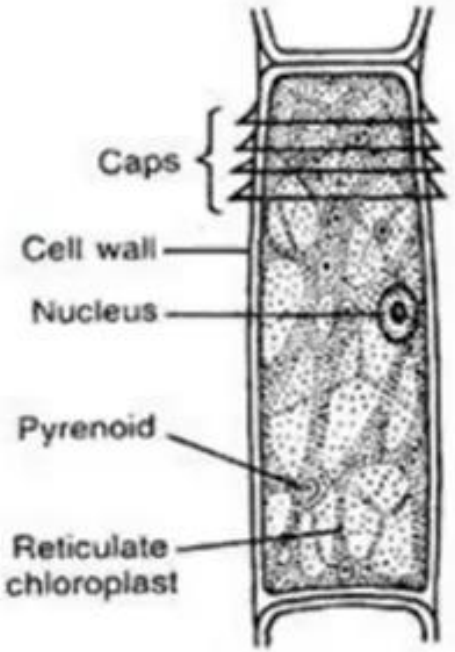
- The Chloroplast is large , parietal and reticulate with number of pyrenoids. (like cladophorales)
- Pyrenoids are covered with starch plates.
- Chloroplast remains embedded in the cytoplasm.
- It extends from one end of the cell to the other end.
- Chloroplast consists of hollow - cylindrical network of broad or narrow, sub parallel meshes.
- **Hoffman** reported microtubules in the chloroplast.
- Each tubule consists of two spirally bound subunits.

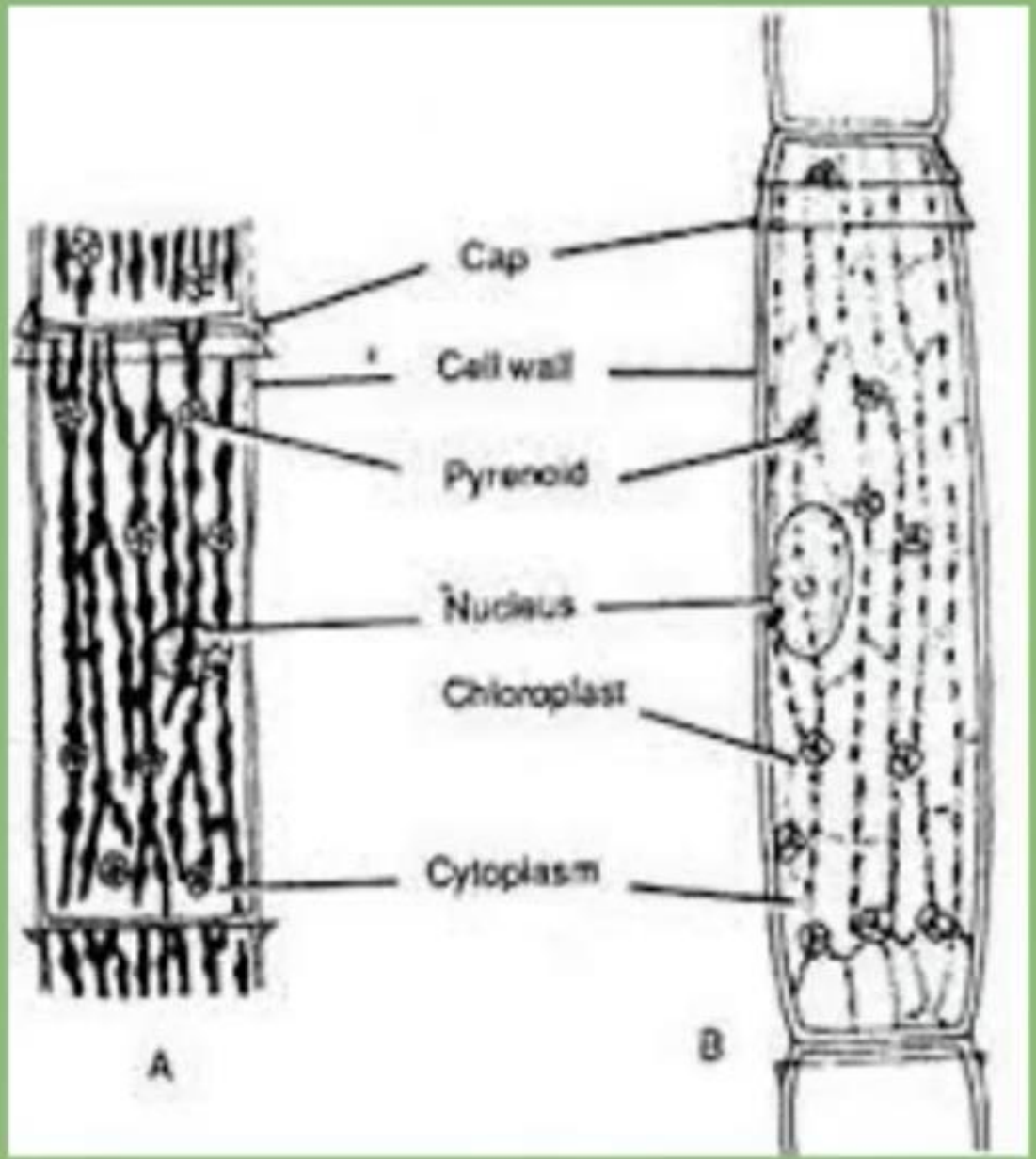
a) A single filament

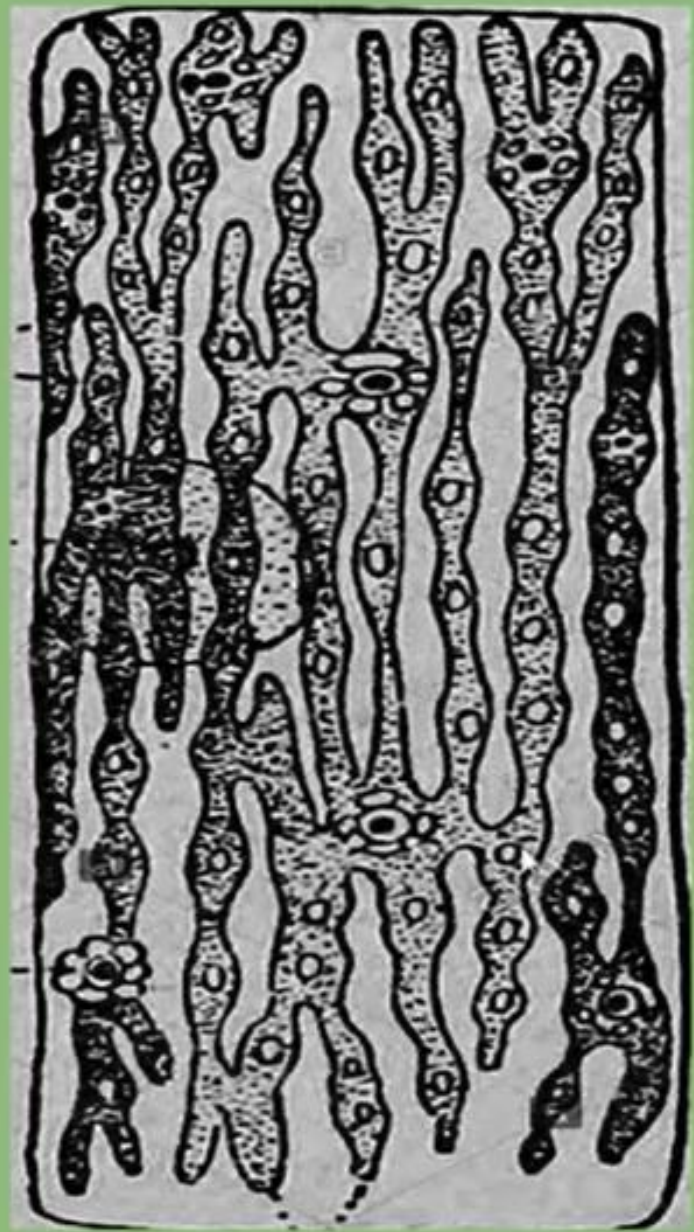


b) A cell enlarged






Cap
Cell wall
Pyrenoid
Nucleus
Chloroplast
Cytoplasm
A
B



Growth and Cell Division

Growth consists increase in the number of cells in the filament.

- Increase in the number of cells place through cell division in intercalary cells.
- All cells except apical and basal cell are capable of dividing though some of the cells of the filament divide.
- These cells have ring like structure after division , so called cap cells.

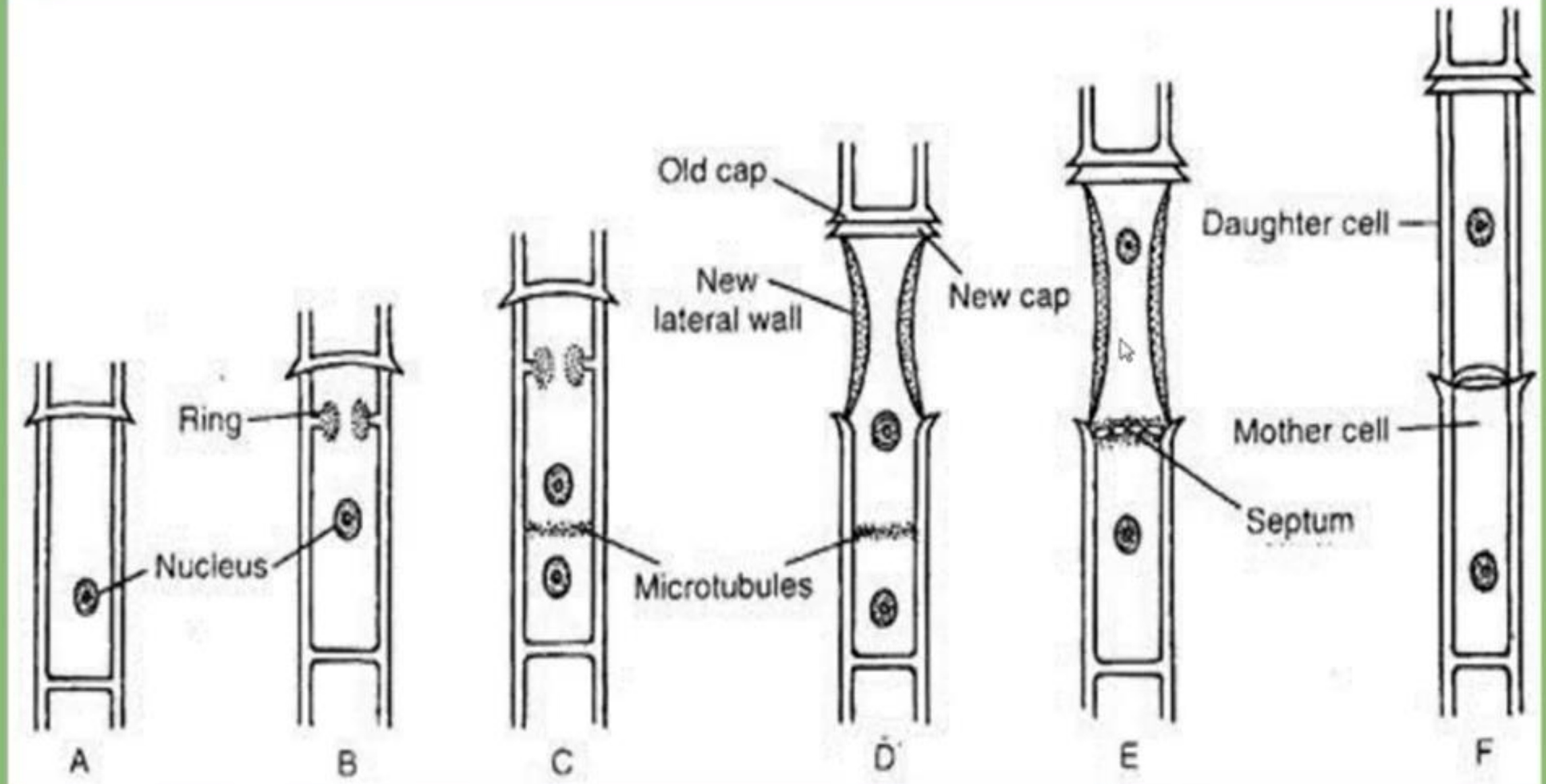
The steps of cell division are

- Initially the nucleus becomes shifted from peripheral position towards the centre and then moves slightly towards the upper half of the cell .

- Ring-like thickening of wall material develops near sub apical region, on the inner face of the lateral wall.
- The ring gradually increases in thickness and become grooved (U shape).
- The nucleus divides mitotically and form two nuclei .
- At the end of cell division (telophase), a row of cytoplasmic strands develop and accumulate as a layer between the daughter nuclei .
- This layer remains in floating condition which will develop the future septum.
- The ring-like thickening gradually elongates and splits the outer and inner wall towards the apical region.

- The ring expands much more and forms a concave cylindrical structure .
- The ring material ultimately forms the cuticle of the upper daughter cell.
- The upper part of the ruptured mother wall remains attached to the anterior end of the new daughter cell as a cap i.e., the apical cap.
- The other part remain towards the basal region of the daughter cell .
- The floating septum gradually goes up to the base of the future daughter cell i.e., at the top of the mother cell at the ruptured end and it becomes fixed .
- Later on it develops into mature cross wall.

- New side wall develops between the cuticle and the plasmalemma of the upper cell.
- Thus the two cells are formed .
- It is evident that the cell with cap is the younger one which develops between the two old cells.


Ring
Nucleus
Old cap
New lateral wall
New cap
Microtubules
Septum
Daughter cell
Mother cell
A
B
C
D
E
F

Oedogonium reproduces by all the three methods:

- **Vegetative**
- **Asexual**
- **Sexual**

Vegetative Reproduction

- It takes place by fragmentation .
- Filaments of thallus breaks into fragments due to

(a) Accidental breaking of the filaments.

(b) Dying of any intercalary cells.

(c) Disintegration of intercalary cells due to formation of spores.

(d) Mechanical injury to the filament.

(e) Change in the environmental conditions.

- The fragments are capable of developing into new filaments.

Asexual Reproduction

- Asexual reproduction takes place by means of zoospores and akinetes.

By Zoospores

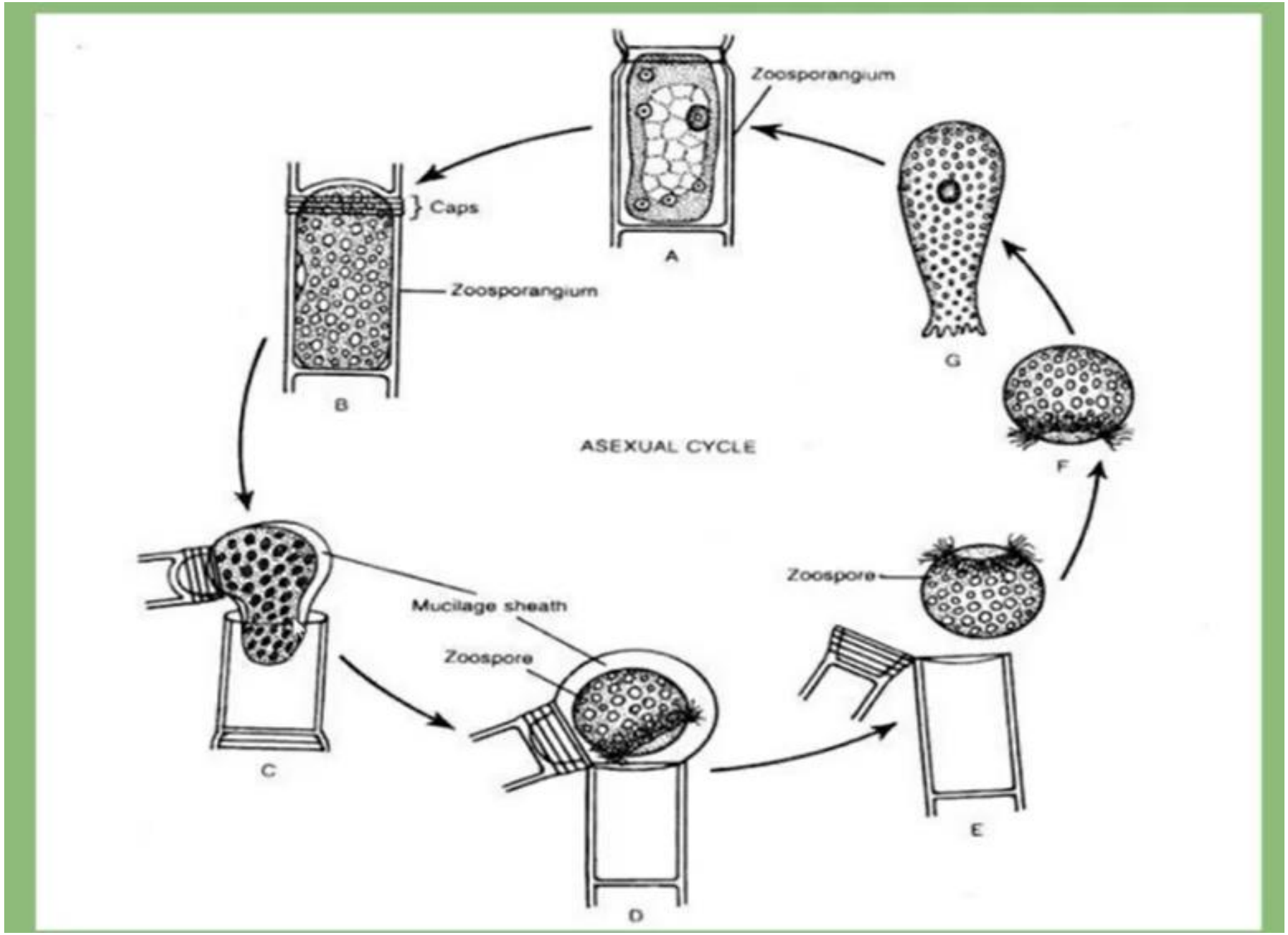
- During favourable condition, any cell with apical cap of the filament, usually younger one behaves as sporangium mother cell.
- The entire protoplast of zoosporangium contracts from the wall and behave as a unit.
- The protoplast becomes round or oval in shape and its nucleus moves at one end.

- Near the nucleus a semicircular hyaline area develops.
- Just below the hyaline area a ring of blepharoplast granules develops, connected with each other by fibrous strands .
- A single zoospore is formed within a zoosporangium.
- The zoospores are multiflagellate and ovoid, pyriform or spherical in shape.
- They are uninucleate with single chloroplast and occasionally with an eye-spot.
- Later on, from each blepharoplast granule, a single flagellum develops.
- Thus a crown of flagella is present around the colourless semicircular area.
- This type of flagella are known as stephonknot.

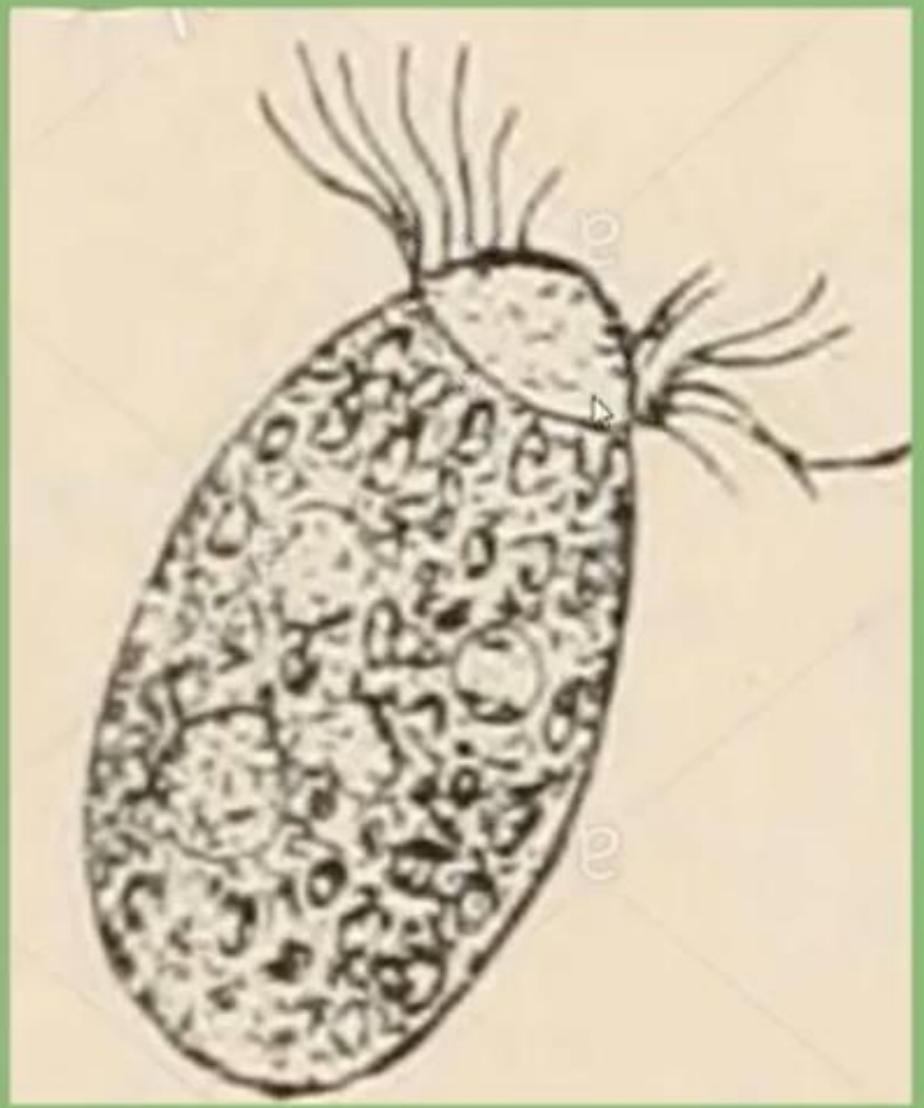
- The fully developed zoospores are liberated by breaking the zoosporangium wall.
- The wall of the zoosporangium breaks near the cap region and the neighbouring cell bend on one side to make way for the liberation of zoospore.
- During liberation, the zoospore remains with in a delicate mucilaginous vesicle for 3-10 minutes.
- After dissolution of vesicle the zoospore gets free and starts swimming in the surrounding water.
- Formation of zoospores generally depends upon the presence of free Co_2.

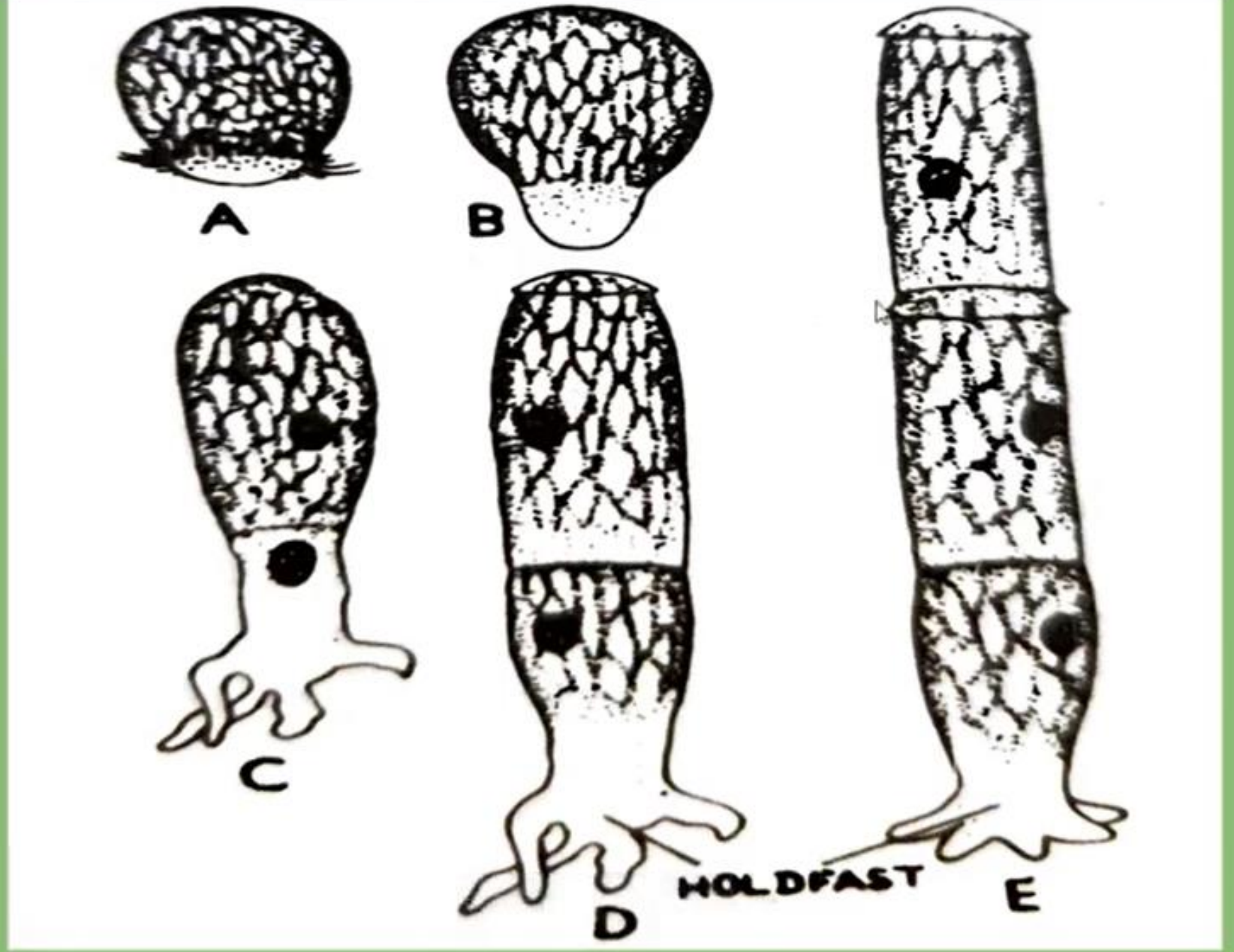
Germination

- The zoospore remain motile for about one hour or more.
- Coming in contact with substratum by the anterior end, it loses flagella and starts to elongate.
- The lower hyaline part becomes separated by cell wall, which forms the basal cell hold fast.
- Cell wall of holdfast does not contain chitinous material.
- Smooth substratum induces a simple holdfast while rough one induces a branched holdfast.
- Upper cell forms new filament through the subsequent division and re-division in a single plane.


Zoosporangium
A
} Caps
Zoosporangium
B
G
F
ASEXUAL CYCLE
Zoospore
Mucilage sheath
Zoospore
C
D
E


Oedogonium sp
zoospores



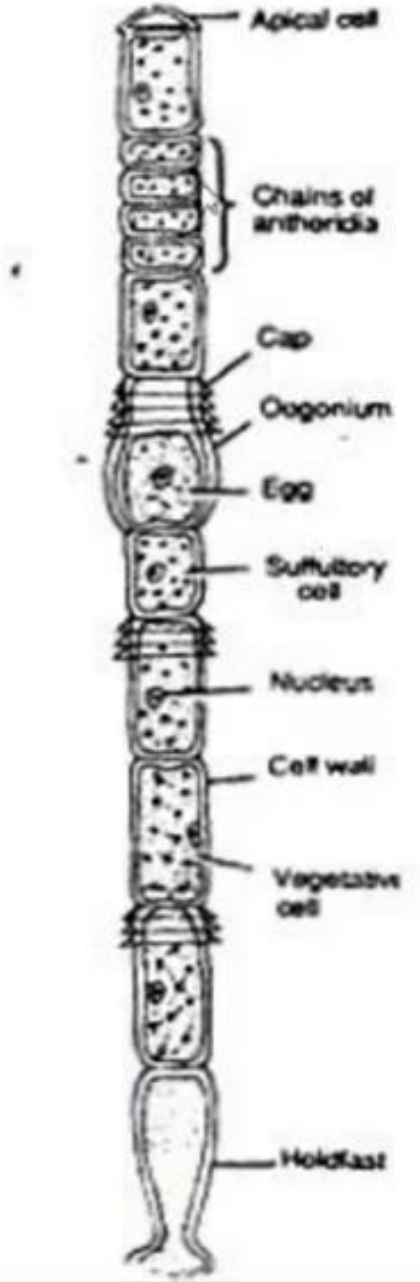

A
B
C
D
HOLDFAST
E

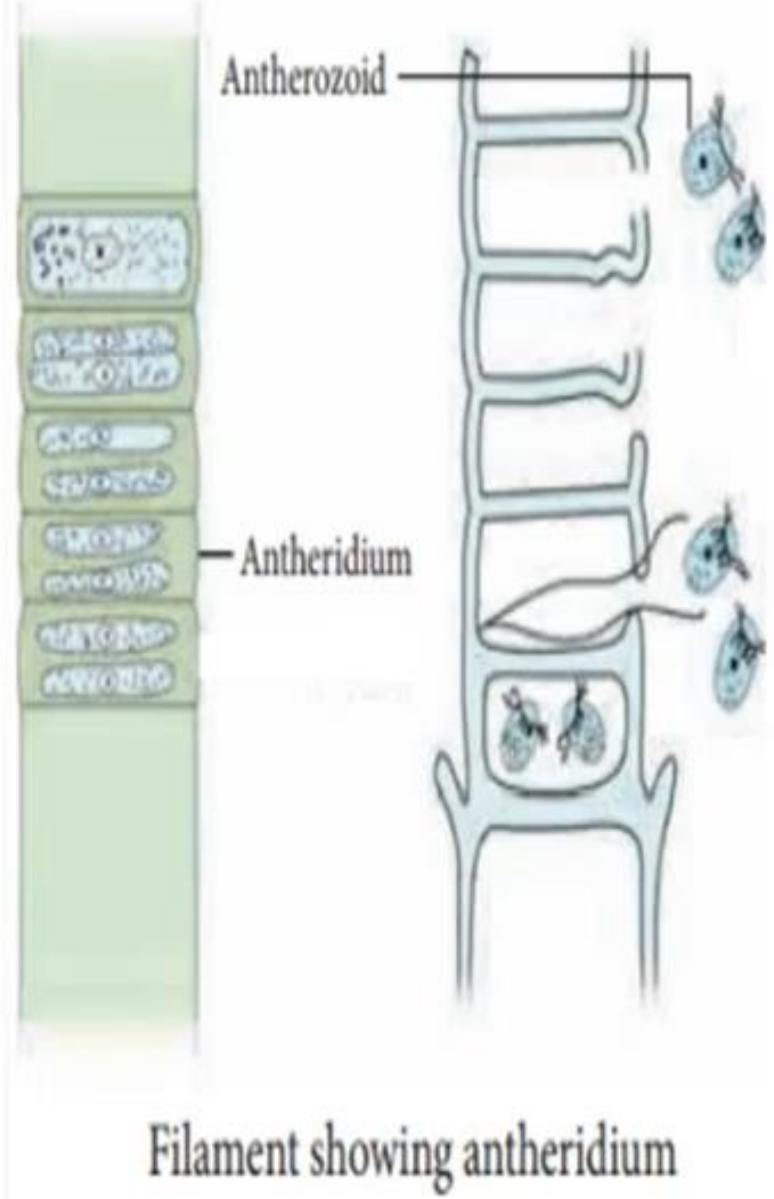
Akinetes

- The akinetes were reported by Wille 1883 and Handa 1928.
- During unfavourable condition the entire protoplast of a cell becomes a thick-walled, reddish-brown, round or oval structure known as akinete.
- Akinetes are formed in chains of 10 to 40 and resembles an oogonia.
- These are rich in starch and orange-red coloured oil.
- The akinete germinates during favourable condition and develops a new filament.

Sexual Reproduction

- During unfavourable conditions (deficiency of nitrogen and alkaline pH) Oedogonium reproduce by sexual reproduction.
- Sexual reproduction can be induced by placing the filament in Co_2 saturated atmosphere.
- It is more common in stagnant water than in flowing water.
- The sexual reproduction is an advanced oogamous type.
- lt takes place with the help of male and female gametes.
- Male gametes are called antheridia and female gametes are called oogonia..
- The antheridium produce antherozoids and the oogonium produce egg.





Filament showing antheridium

- Male and female gametes differ both morphologically and physiologically.
- Only one egg is produced in each oogonium and two antherozoids in each antheridium.
- Another motile structure, the androspore, is produced singly in each androsporangium. It is formed in macrandrous sps.

On the Basis of size of the male (antheridial) filament the species of Oedogonium are divided into two groups **macrandrous** and **nannandrous** type:

- **1. Macrandrous Type:** In these sps. the antheridia develops on the filaments of normal size. It is of two Types.

    1. Monoecious type (homothallic or bisexual) - In this type (e.g., *O. fragile, O. nodulosum and O. hirnii)* antheridia and oogonia are borne on the same filament.

    2. Dioecious type (heterothallic or unisexual) - In this type *(e.g., O. gracilius, O. cardiacum and O. aquaticum)* the antheridia and oogonia are borne on the different filaments.

- **Nannandrous Type**

  The nannandrous species are always dioecious (heterothallic) i.e., antheridia and oogonia are borne on different filaments.

  In this type the antheridia develop on a very small filament termed as dwarf male or nannandrium.

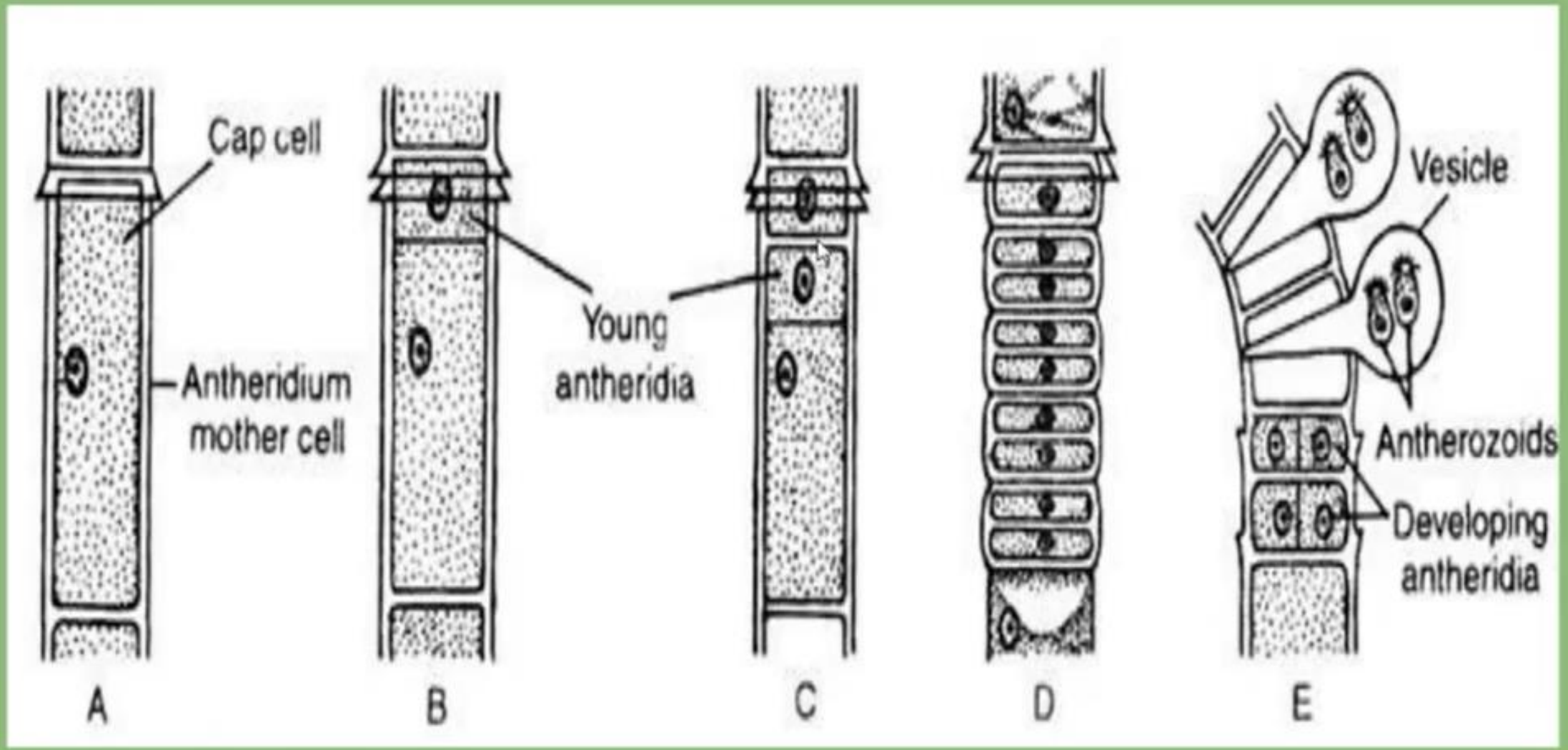
Sexual Reproduction in Macrandrous Species

- The structure and development of antheridium and oogonium are similar in all the species belonging to either monoecious or dioecious type.
- They differ only in the position of sex organs.
- In monoecious type both the sex organs develop on the same filament, but in dioecious type they are on different filaments.

Development of Antheridium

- Any cap cell of the vegetative filament may function as antheridial mother cell.
- It divides transversely into an upper smaller antheridium and a lower larger sister cell.
- The sister cell then undergoes several transverse division and form an uniseriate row of about 2-40 flat, rectangular, uninucleate antheridia.
- The nucleus of the each antheridia undergoes mitotic division and forms 2 nuclei.
- Each nucleus becomes surrounded by some cytoplasm and metamorphoses into an antherozoid.

- Thus each antheridium produces two antherozoids.
- In *O. cardiacum* four antherozoids are formed in one antheridium.
- The antherozoids are unicellular, uninucleate, multiflagellate and yellowish in colour.
- Morphologically it is similar to zoospore, but much smaller in size and have fewer flagella.
- The liberation of antherozoid is similar to zoospore formed during asexual process.
- The antherozoids swim in water for sometime and in contact with receptive pore or slit, antherozoid enters inside the oogonium and fertilizes the egg.


Cap cell
Antheridium mother cell
Young antheridia
Vesicle
Antherozoids
Developing antheridia
A
B
C
D
E

Sexual reproduction in Nannandrous sps

- Development of oogonia is same as in Macrandrous sps.
- Antheridia are developed on dwarf filament.
- Dwarf filaments are developed from androspores.
- Androspores are produced in androsporangia.

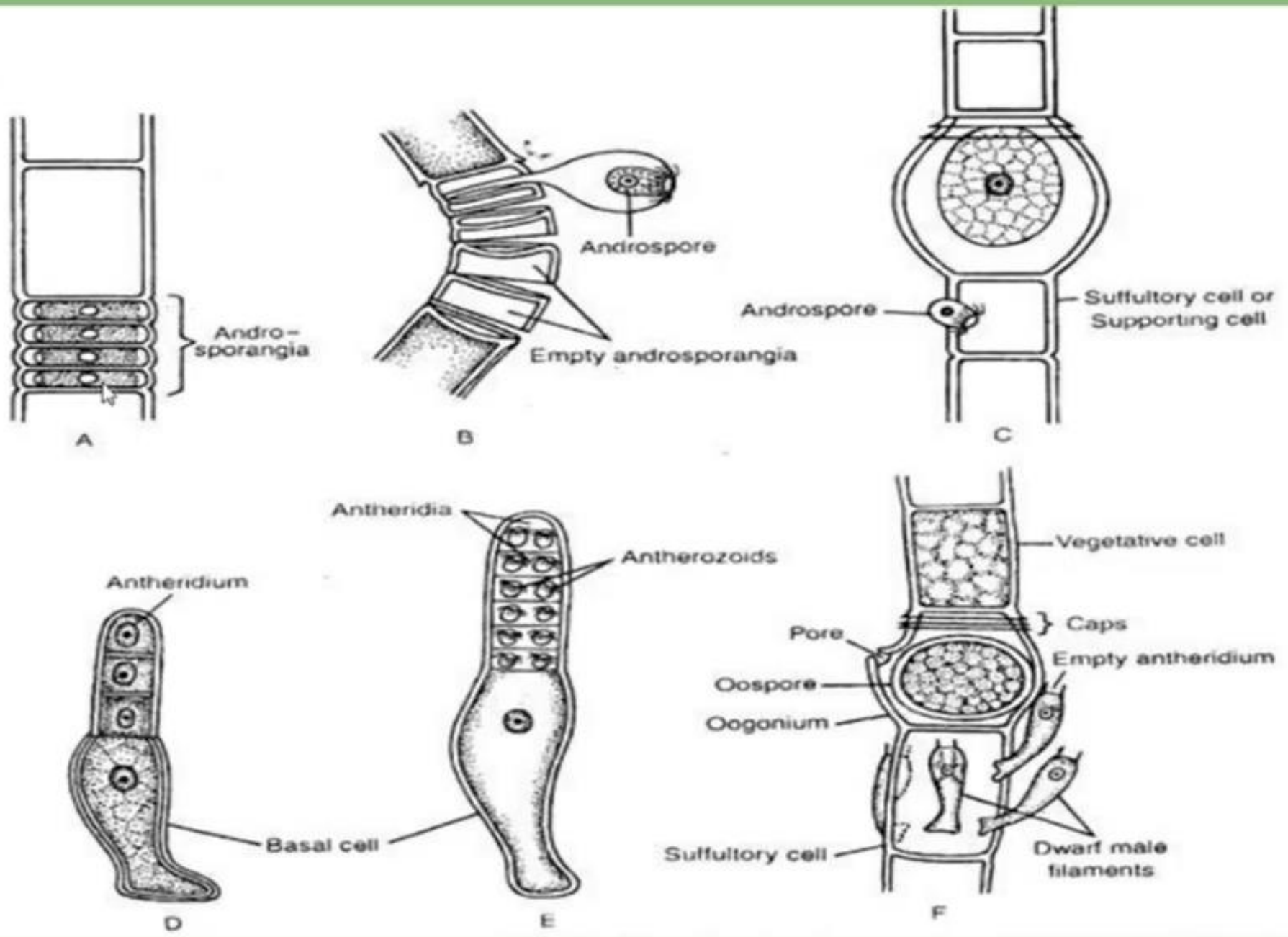
- Nannandrous sps are of two types on the basis of presence of androsporangia and oogonia.

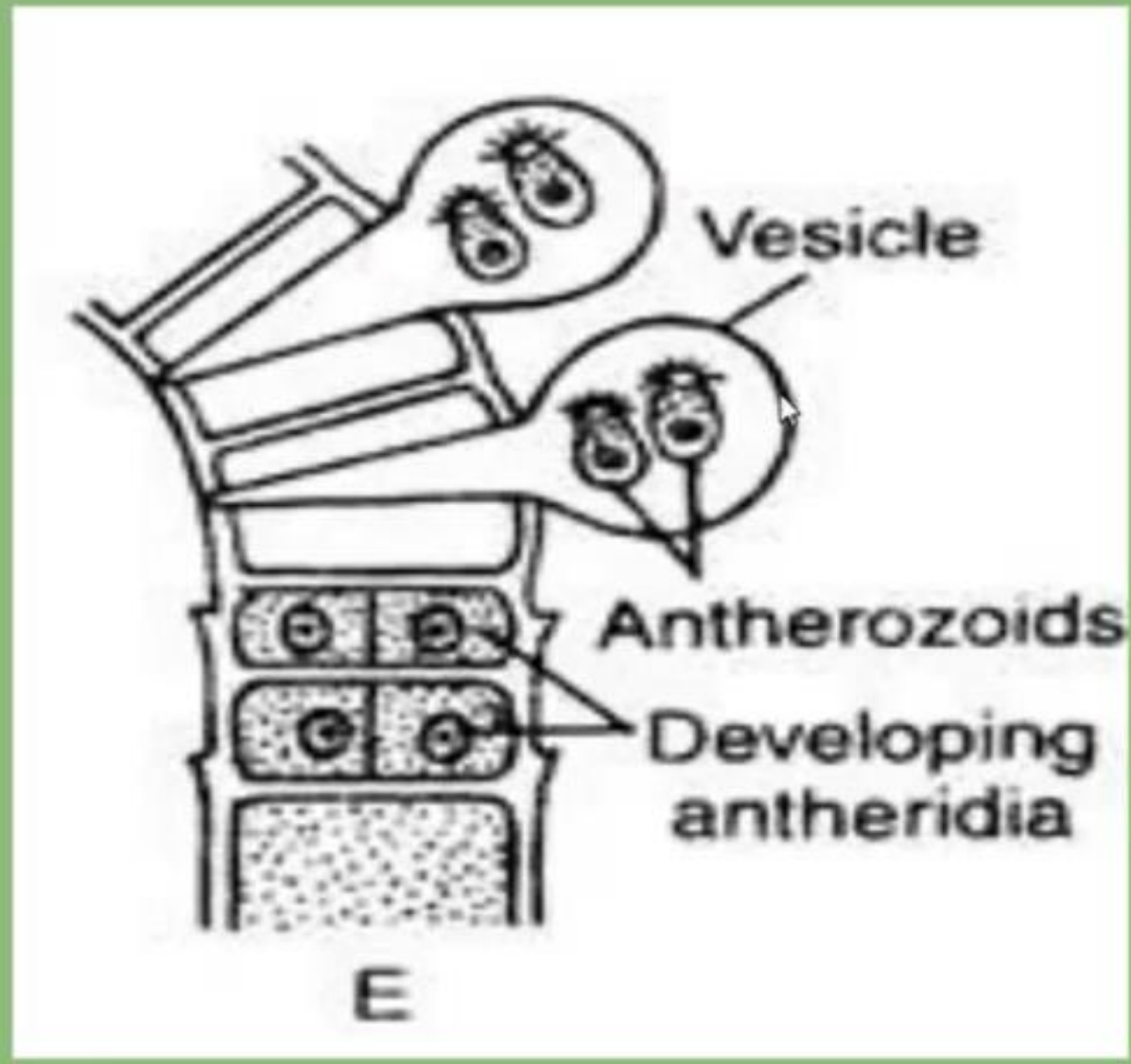
  i. Gynandrosporous Type - In this type (e.g., *O. concatenatum*) the androsporangia and oogonia are borne on the same filament.

  ii. Idioandrosporous Type - In this type (e.g., *O. setigerum, O. confertum and O. iyengarii*) the androsporangia and oogonia are born on different filaments .

Germination of Androspore and Formation of Antherozoids

- After swimming for some time, the androspore germinates on the oogonial wall (*O. ciliatum*) or on supporting cell (*O. concatenatum*) and forms dwarf male filament.
- Towards the apical region, the dwarf male filament cuts off small cells as the antheridial mother cells.
- Antheridial mother cell forms antheridium as in Macrandrous sps.
- Each antheridium produces two antherozoides.


Andro-
sporangia
A
Androspore
Empty androsporangia
B
Androspore
Suffultory cell or
Supporting cell
C
Antheridia
Antherozoids
Antheridium
Basal cell
D
E
Vegetative cell
} Caps
Pore
Empty antheridium
Oospore
Oogonium
Suffultory cell
Dwarf male
filaments
F


Vesicle
Antherozoids
Developing antheridia
E

- The androspores, antherozoids and zoospores are morphologically alike but differ in their sizes.
- The androspores are smaller than zoospores (produced asexually) but larger than antherozoids.


Thank you