## SPIROGYRA

**SYSTEMATIC POSITION :**

Kingdom — Plantae
Sub kingdom — Thallophyta
Division — Chlorphyta
Class — Chlorophycease
Order — **Conjugales/Zygnemales**
Family — Zygnemaceae/Zygnemataceae
Genus — **Spirogyra**

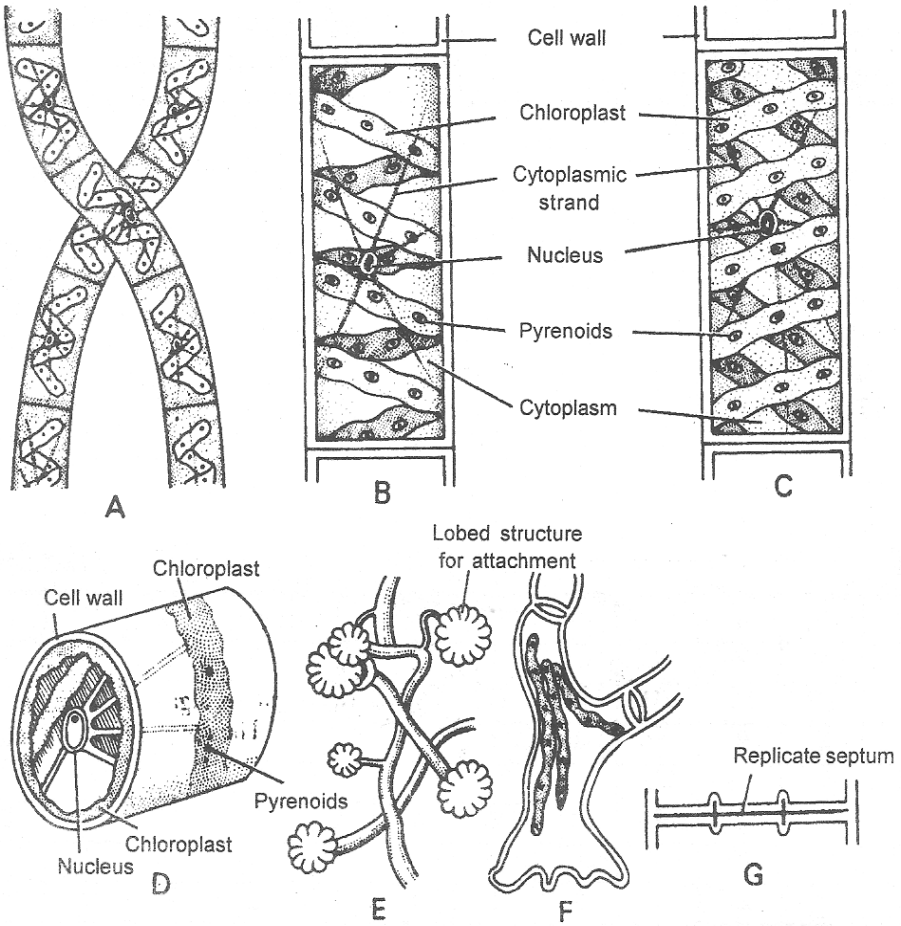
**Note :** Spirogyra was discovered by Lin.

**HABIT AND HABITAT**

- It occurs in **stagnant fresh water** s **free floating.** It occurs in water of chaning temperature.
- **Spirogyra adnata** = Occurs in stream and river, " Pon"

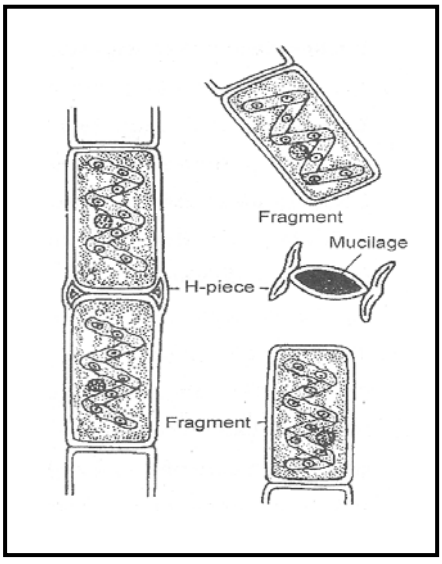
  Common mane - **"Pond Scum" "Pond Silk"** or **"Water Silk"** or **Mermaids'** tresses.

  **STRUCTURE:**




*Spirogyra : A - two filaments B–C Detailed structure of a cell, D.T.S. of a cell, E–Hold fast of Spirogyra, F.Hold fast of Spirogyra, G.Replicate septum*

- **Spirogyra** is a **multicellular, unbranched** and **filamentous** algae. It is olive-green in colour.
- All the cells are similar in shape, size and structure. These are arranged in a linear row.
- Hold - fast is normally absent but ***S.fluvitatalis*** contains hold-fast.
- Cells are rectangular or **cylindrical.** Lenght is more as compared to width.
- Cell wall is **double layered,** outer layer is made up of pectose (which gets changed into pectin, which dissolves in water to form a mucilagenous sheath) and inner layer is made up of cellulose.
  **Note :** Filament is silky smooth due to presence of pectin in outer layer. Due to this reason epiphytes are not attached with filament.
- Each cell contains a large central vacuole. Cytoplasm ocurs in the form of a thin layer around the vacoule. Thin layer of cytoplasm is called **"primordial utricle".**
- Cytoplasm contains a large nucleus and it is held by cytoplasmic fibres.
- Each cell contains **spirally coiled or ribbon-shaped** chloroplast, with a left **handed twisteing (sinisral).**
- Number of chloroplast varies from **one to sixteen** in each cell (according to species). (Single chloroplast was recorded in **S. Venkataramanii)** and 16-chloroplsts in **S-rectispora)**
- Margins of chloroplast are **smooth** or **serrate** or **saw shaped.**
- Chloroplast have **many** Pyrenoids.
- Spirogyra grows in length by **intercalary** growth.
  **Note :** Some species contains **rhizoid like out growths.**
  e.g. ***S.affinis*** ***S.dubia*** ***S.rhizobrachialis***




**REPRODUCTION**

**(1) Vegetative reproduction -**

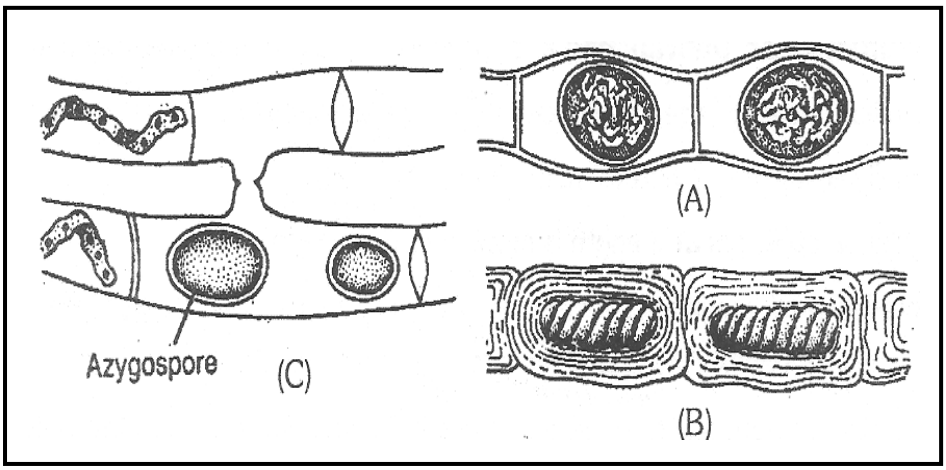
- It takes place by **fragmentation**
  Fragmentation takes place by -
  **(i) Accidental breakage**
  **(ii) Dissolution of middle-lamella**
  **(iii) By the formation of H-shaped segments -**
  E.g. **Spirogyra colligate**
- In some species cell-wall between two cells form **H-shaped** thickening, called **replicate wall / replicate septum**
- Middle lamella of these cells dissolves and both cell remain connected by replicate wall.
- Replicate wall facilitates **fragmentation** which dissolution of cells.

**(2) Asexual reproduction :** Normally asexual reproduction is absent in **Spirogyra.** It takes place only in some species by the following methods -

**(A) By aplanospore** formation - **e.g. *S.aplanospora***

**(B) By akinete** formation

- Under unfavourable conditions, the cells of a filament develop into thick walled structures. Such thick walled structures are called as **akinates.**
- Thick cell-wall of akinete is made up **cellulsoe** and **pectose**. In akineetes, food has been accumulated.
- When favourable conditions return, akinete **directly germinates** to form a new thallus.
  e.g. ***S-farlowii.***




**(c) By Parthenospores or Azygospores -**

- When gametes fail to fuse they form **parthenospore.** Sudden variation in environment leads to the formation of parthenospores.
- **"Kleb"** artifically induces the formation of parthenospores in ***S.varians*** by placing it in **sugar solution.**
- In ***S. deadalea*** both the gametes from parthenospores **in situ** (at their original place)

  **Zoospores** are totally **absent** in **Spirogyra.** It's reproductive structure are **non flagellated.**

  **Note :** In ***S.rhizoides*** parthenospores are developed from **rhizoids.**

**(3) Sexual reproduction**

- It takes place towards the end of growing season-usually in the late spring.
- It takes place by **conjugation.** Gametes are **non-ciliated** or **non-flagellated** and oval shape.
- Eye spot is absent in gametes.
- Gametes perform **ameoboid movement** during conjugation.
- Gameetes of Spirogyra are called **aplanogametes** (due to the absence of cilia or filagella).
- **Physiological anisogamous** type of sexual reproduction is found in ***Spirogyra.***

  Following conditions which favour the process are :

  (i) Nitrogen deficiency

  (ii) The change in pH of the aquatic medium an alkaline side.

  **Type of Conjugation**

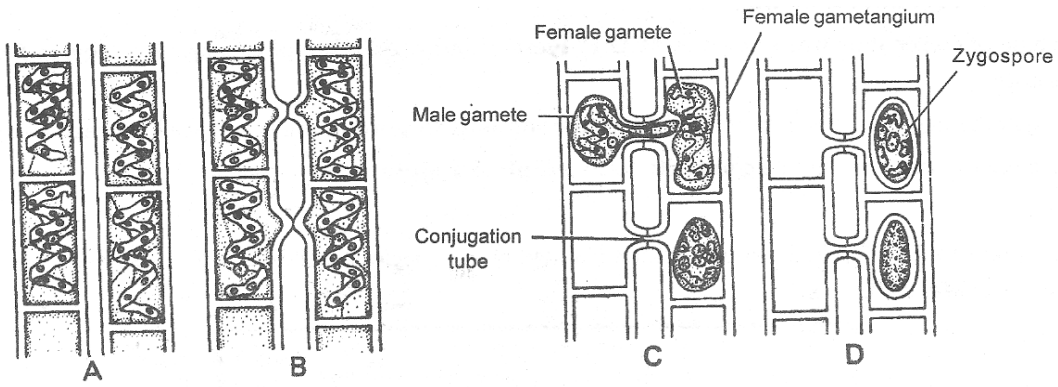
  (i) Scalariform of Ladder like conjugation

  (ii) Lateral conjugation

  **(i) Scalariform Conjugation :**

- It is most common type of conjugation and occur in **"heterothallic"** species of **Spirogyra.**
- It mainly takes place during **night.**
- To filaments arrangement parallel to each other. After some time cells of two filaments opposite to each other form **cylindircal out growths** which fuse to form a **conjugation tube.**
- Cell united by conjugation tube is called **aplanogametangia.** Ptoplast of gametangium constricts to form gamete. In the cells of one filament, male gametes are formed and in the cells of another filament female gametes are formed.
- Male gamete perform **amoeboid movement** and migrate to female gametangium through **conjugation tube,** it fuses with female gamete to form a **diploid zygote.**

  **After this three layered wall is formed around the zygote, now it is called zygospore.**




**Spirogyra – Transfer of one aplanogamete to other aplanogametangia**

A. Two filaments lying parallel to each other, B. Formation of papillate outgrowths to form conjugation tube, C.Ladder-like (Scalariform) conjugation. One aplanogamete moving into the aplanogametangia of the other filament, D.Zygospores formed in one filament and empty aplanogametangia of the other filament.

- In scalrifom conjugation cells of one filament because empy and the other filament contains **zygospore** in its cells.

**Note :** Zygote is initially green but soon after chloroplast of male gamete degenerate followed by the degeneration of chloroplast of female gamete. Due to this reason the filaments of **Spirogyra** do not remain green after fusion.

**(ii) Lateral conjugation :**

It takes place between **adjacent cells** of the **same filament.** Laeral conjugation occurs in **homothallic species** of **Spirogy0ra.** lateral conjugation is of **two types -**

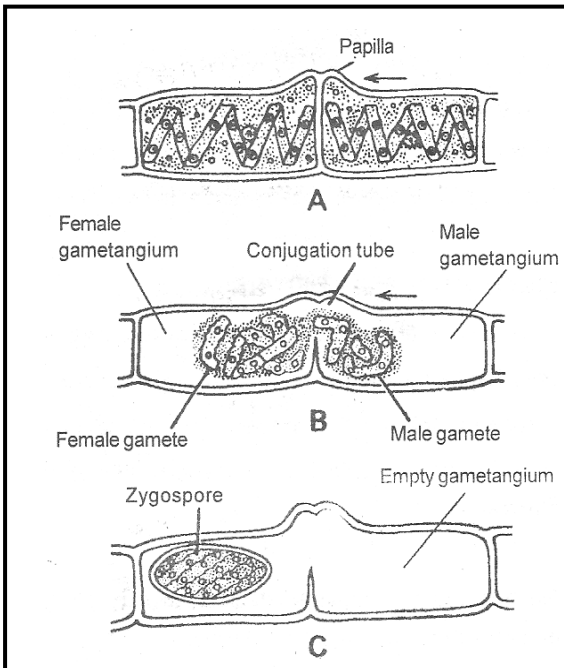
**(a)** Indirect lateral conjugation

**(b)** Direct lateral conjugation

**(i) Indirect lateral conjugation/chain conjugation**

- Protoplast of cells contricts to form gametes.
- Male and female gameetes are formed in **adjacent cells** of a filament.
- Each cell form **tubular/papilla-like out growth** in their lateral wall.
- Out growths of two cells fuse to form **conjugation tube.**
- Male gamete migrates through conjugation tube and fuses with female gamete to form zygospore. After the completion of conjugation the filament contains empty and zygospore containing cells in alternate manner.

**Example :** S . affinis.



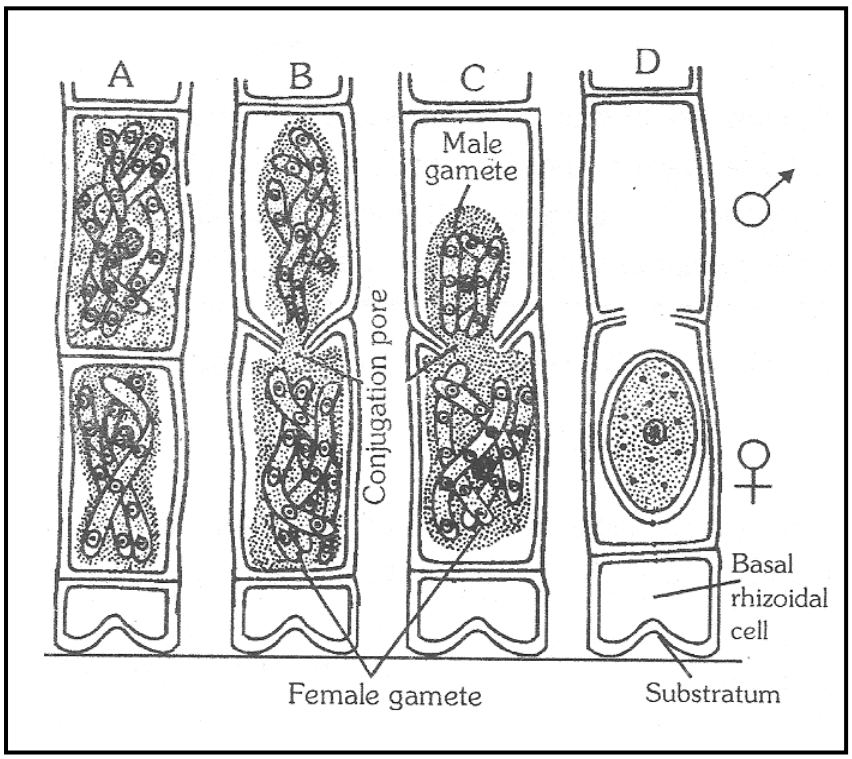

***Spirogyra affinis – Indirect lateral conjugation/chain* conjugation**

**(ii) Direction Internal conjugation**

- this type of conjugation was studied by **M.O.P. Iyengar** (father of Indian phycology/Algology) in ***Spirogyra jogensis.***
- Male gamete migrates to adjacent cell through a **conjugation pore** in transverse wall between two cells.
- Male gates fuses with female gamete to form as **diploid zygote.**

**Note :**

Direct latera conjugation in the **monoecious** filament of this species usually takes place between two cells next to the **rhizoidal cell.**




**STRUCTURE OF ZYGOSPORE -**

Wall of zygospore is three layered -

(i) **Exosporium** - Thin layer of cellulose (Mainly) and pectin.

(ii) **Mesoporium -** Brown, thick ornamented and cutinised.

(iii) **Endosporium -** Thin & made up of cellulose

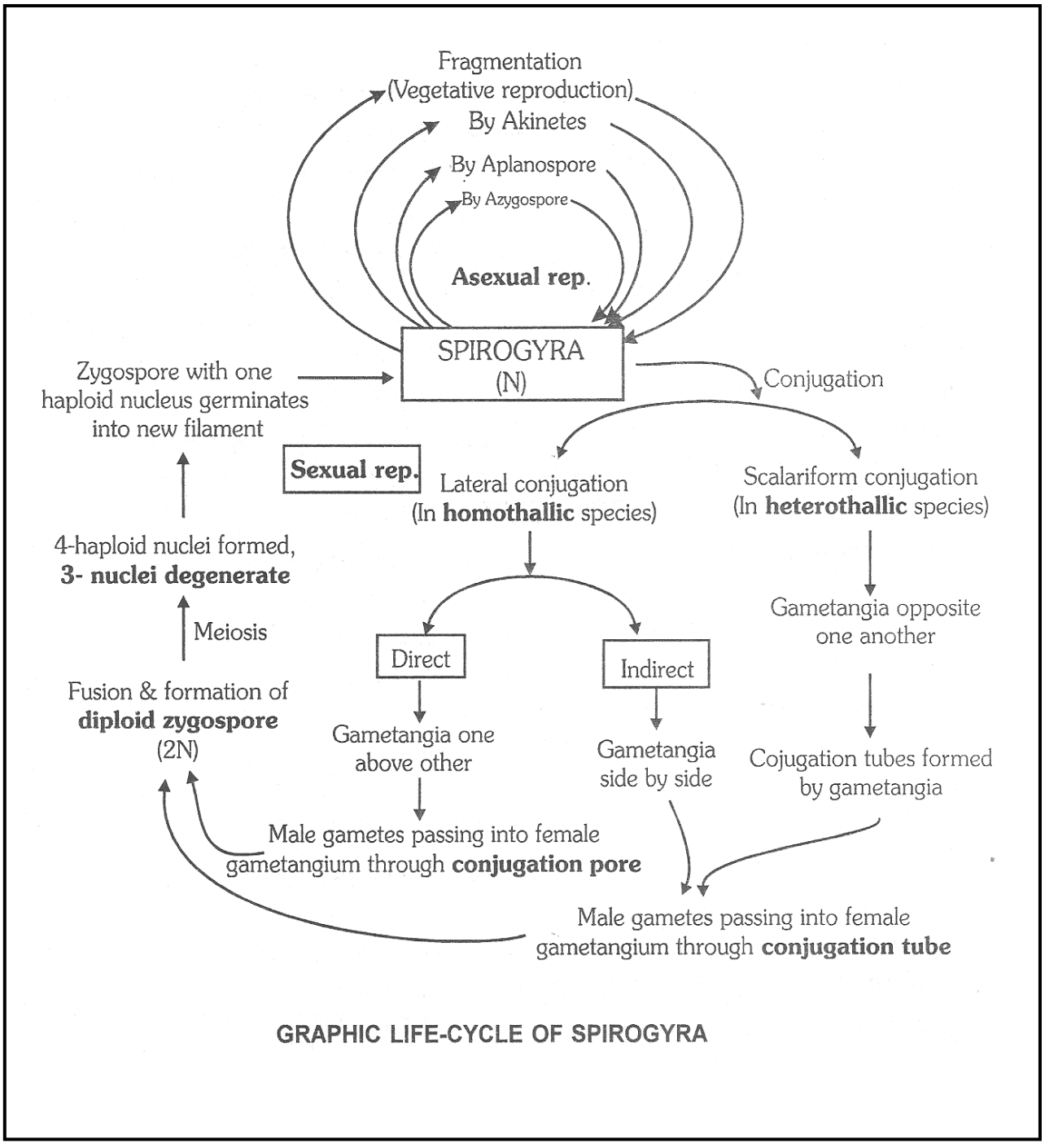
**GERMINATION OF ZYGOSPORE**

- Germination takes place in **favourable conditions.** (Sometimes after rainy season)
- four haploid nuclei are formed inside the zygospore and a result of **meiosis.**
- **three nuclei are degenerate** and only one nucleus remains functional.
- Now functional nucleus of zygospore undergoes repeated mitotic division to form a haploid filament of **Spirogyra.**

**Note** : During germination of zygospore in spirogyra expsporium and mesosporium ruptures and endosporium emerges in form of cylindircal tube.

**LIFE CYCLE**

- Life cycle of spirogyra is **"haplonit type"**




GRAPHIC LIFE-CYCLE OF SPIROGYRA