REPRODUCTION IN ALGAE

Generally, all three types of reproduction are observed in algae, such as:

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

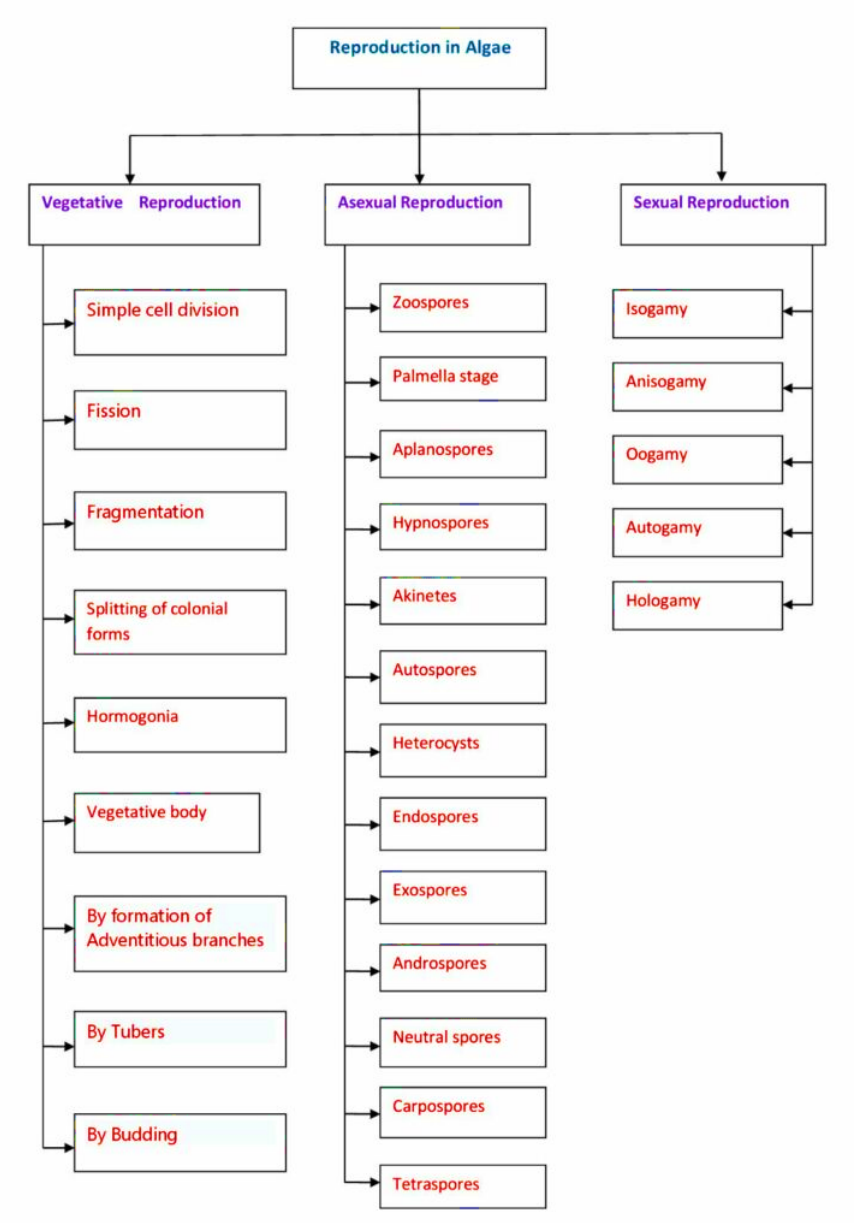

Figure: Different types of Algal reproduction

Vegetative Reproduction in Algae

The method by which new individuals are formed directly from the vegetative parts without any change in the protoplast is called vegetative reproduction.

It takes place by the following methods, such as:

Simple Cell Division

This type of reproduction is found in unicellular algae.

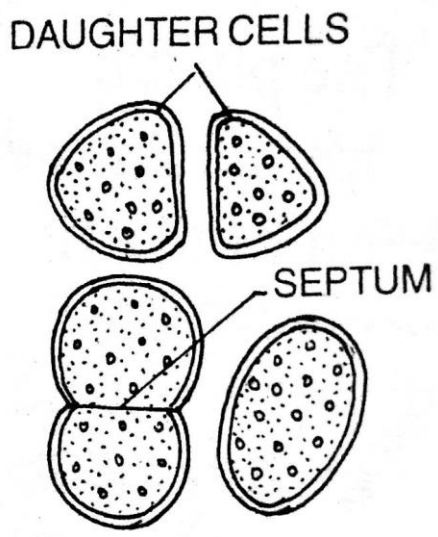

Figure: Cell division in Synechococcus

It takes place simply by cell division, in which one cell divides to form two cells, e.g., Synechococcus of Cyanophyceae.

Fission

In fission, the cell is divided by the formation of a deep constriction (septum formation) on the sides of the cell.

This method of reproduction is common in diatoms and other unicellular algae.

Fragmentation

The fragmentation method is very common in filamentous algae of the Chlorophyceae and Phaeophyceae. The plant body (filament) breaks up into one or more fragments. Each fragment may give rise to a new plant by the division of cells.

Spirogyra, Ulothrix, Zygnema, Oscillatoria, Oedogonium, Cylindrospermum, etc. are common examples of fragmentation.

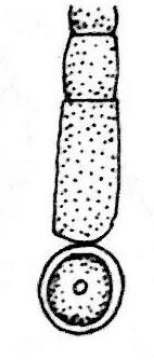

Figure: Fragmentation of Cylindrospermum

Fragmentation of the filament may take place:

- Mechanical fragmentation
- Water force-induced fragmentation
- Fragmentation due to biological means:
- Fragmentation is due to the presence of special structures in filaments

Splitting of Colonial Forms

In this type, the mature colonies are split up into one or more small parts, each of which gives rise to a new mature colony.

This method may be included in the fragmentation type, e.g., Aphanothece, Dictyosphaerium, etc.

Hormogonia

Algal forms of the group Myxophyceae and Cyanophyceae are vegetatively reproduced by the method of hormogonia. Trichomes of algae break up into hormogonia (small fragments) and each hormogonium grows to form a new plant.

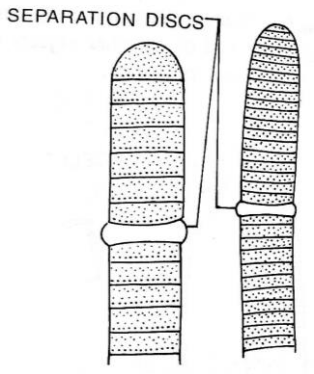

Figure: Hormogonia in Oscillatoria

For example, Nostoc, Cylindrospermum, Oscillatoria, etc.

Vegetative Body

In some forms, such as Chara and Nitella Vegetative bodies like Amylum stars and bulbils develop on the plant body, which they detach and give rise to a new plant.

By Formation of Adventitious Branches

In some algae, adventitious branches are formed in the large thallus.

When these branches are separated from the parent thallus, they develop into new plants, e.g., Dictyota, Fucus, etc.

By Tubers

In some rhizoidal portions of Chara or in internodal portions, some cells accumulate starch and other food substances and get swelled to form tuber-like structures.

When these tubers get separated from the parent thallus, they are capable of developing new plants.

By Budding

In Protosiphon and some other algae, vegetative reproduction takes place by budding. During bud formation, a proliferation of vesicle-like structures initially occurs, which gets separated from the parent cell by a septum.

These buds have the power to generate new plants.

Asexual Reproduction in Algae

In several groups of algae, asexual reproduction can be seen. It involves the multiplication of species by the formation of specialized reproductive cells called asexual spores.

In this method, small sporangia are developed in which spores are formed either in the whole plant or in part of the plant. These spores germinate to give rise to a new plant.

It occurs by the following methods:

Zoospores

The zoospores are flagellated motile naked spores (asexual structures) which may be formed either within a specialized structure called a zoosporangium or from the vegetative cell.

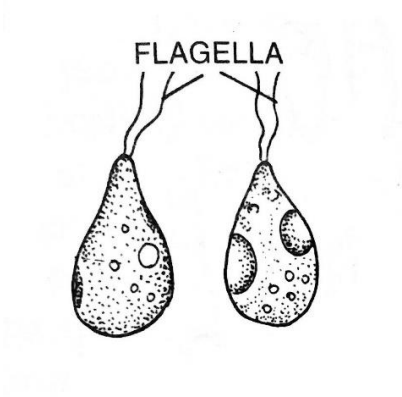

Figure: Biflagellate zoospores

The zoospores may be **biflagellate** (with two flagella, e.g., Chlamydomonas), **quadriflagellate** (with four flagella, e.g., Ulothrix), or **multiflagellate** (with many flagella, e.g., Oedogonium).

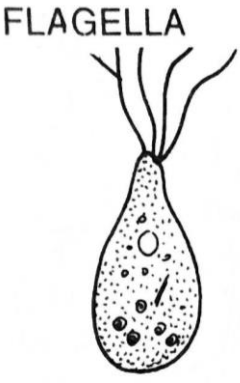

Figure: Quadriflagellate zoospore

Zoospores are formed under favourable conditions. When the zoospores mature, the parental wall raptures and release them. They swim in the water, drop their flagella and germinate to give rise to new plants.

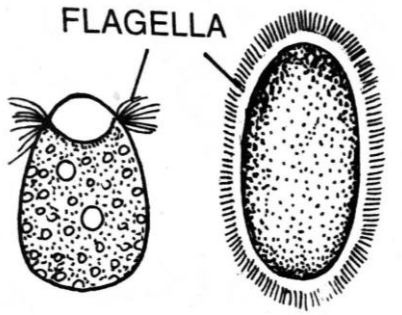

Figure: Multiflagellate zoospores

Palmella Stage

In some algae, such as Chlamydomonas, the zoospores alter their formation, are not able to get out of the parent cell, and remain involved in a mucilage sheath. The non-motile daughter cells may divide again and form a colony-like structure called the palmella stage.

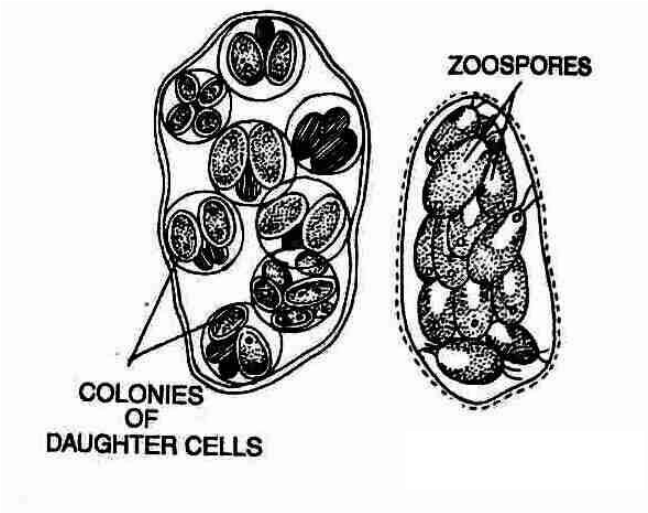

Figure: Palmella stage of Chlamydomonas

During unfavourable conditions, this stage is found. With the onset of favourable conditions, each daughter cell develops into a new plant.

Aplanospores

In unfavourable conditions, instead of zoospores, aplanospores are formed. Aplanospores are thin-walled, non-flagellated, non-motile spores formed in some aquatic algae(e.g., Chlorococcus, Ulothrix, Microspora, etc.).

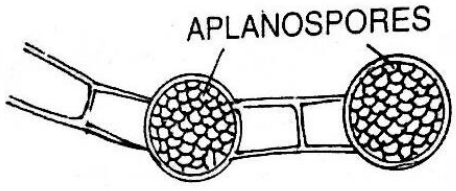

Figure: Aplanospores of Microspora

Each aplanospore is surrounded by a definite wall that is distinct from the parent cell wall.

The aplanospore comes out of the parent cell and forms a new plant with the onset of favourable environmental conditions.

Hypnospores

When aplanospore-like structures are enveloped by a thicker wall with abundant food reserves, then such spores are called hypnospores. They are formed under unfavourable conditions.

Each hypnospore germinates after a resting period to give rise to a new plant, e.g., Pediastrum, Sphaerella.

Akinetes

In Cladophora and Pithophora, the complete cell develops a very thick wall around it during dry conditions called akinetes.

Akinetes, under suitable environmental conditions, germinate into new plants.

Autospores

Autospores are non-motile spores that resemble the parent cell in shape and structure (when autospores are present in the parent cell, they start metamorphosing into parent-like cells). They are also called resting spores.

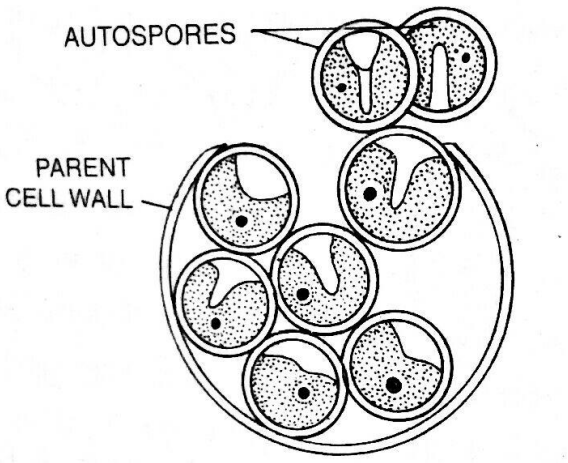

Figure: Autospores of Chlorella

Autospores are formed under favorable conditions, e.g., Chlorococcus, Chlorella, Scenedesmus, etc.

Heterocysts

Heterocysts are abortive, specialized, larger, thickened spore-like vegetative cells of some filamentous algae.

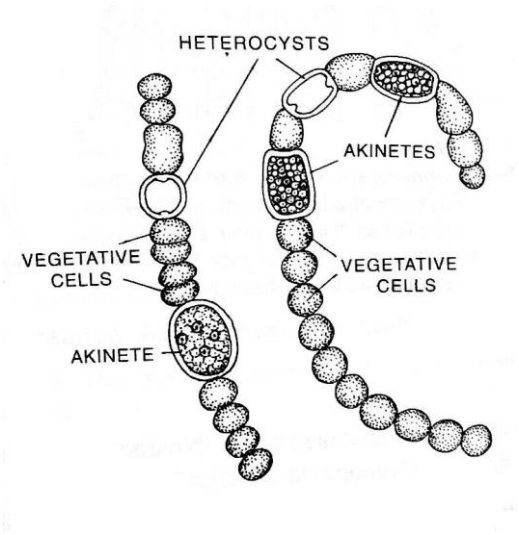

Figure: Anabaena showing akinetes and heterocysts

In exceptional cases, each heterocyst germinates to produce a new filamentous plant, e.g., Nostoc, Rivularia, Anabaena, etc.

Endospores

Endospores are non-flagellated, thin-walled spores formed inside the cells of members of the Rhodophyceae.

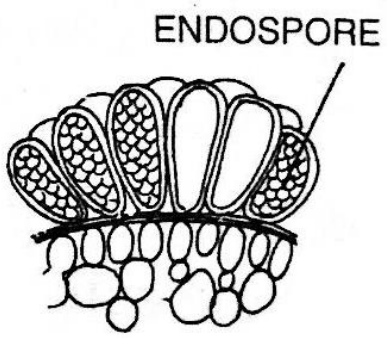

Figure: Endospores of Dermocarpa

Each endospore germinates into a new individual plant, e.g., Dermocarpa.

Exospores

These are thin-walled, non-flagellated spores like endospores but formed outside the cells.

Exospores are found in some unicellular algae, e.g., Chamaesiphon.

Androspores

They are motile, multiflagellated, and formed in androsporangia. On germination, androspores form dwarf males, e.g., Oedogonium.

Neutral Spores

They are formed in Plurilocular sporangia in members of Phaeophyceae. Neutral spores or neutral zoospores germinate to form the same diploid plants(sporophytic plants).

Carpospores

In some members of the Rhodophyceae, carpospores are formed in the carposporangium. Carpospores germinate to give rise to tetrasporophyte.

Tetraspores

In Polysiphonia and some other members of Rhodophyceae, tetraspores are formed in tetrasporophyte sporangia. On germination, these non-motile spores give rise to new male and female plants.

Sexual Reproduction in Algae

Sexual reproduction takes place by the fusion of the sexual reproductive units called **gametes**. Gametes are haploid structures and are formed in sac-like **gametangia**.

When male and female gametes are on the same thallus, the condition is called a homothallic condition or stage. While male and female gametes are present on different thalli, the condition is called a heterothallic condition or stage. The haploid gametes fertilise to form a diploid zygote.

On the basis of behavior, function, and structure of gametes, sexual reproduction is of the following types:

Isogamy

This is a simple type of sexual reproduction in which fusing gametes are morphologically similar and are called isogametes.

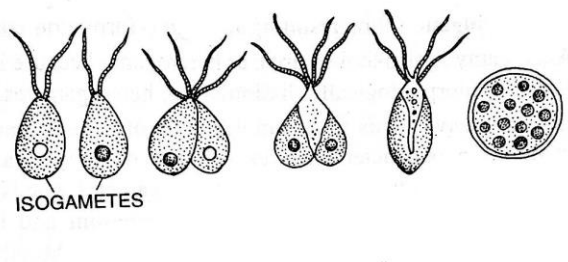

Figure: Different stages of isogamy

The fusing gametes may be motile (with flagella) or non-motile (without flagella), e.g., Chlamydomonas, Ulothrix, Cladophora, Zygnema, etc.

Anisogamy

In anisogamy, the fusing gametes are morphologically alike (may vary in size and form) but dissimilar in behaviour, and are called anisogametes or heterogametes.

The gametes are formed in different gametangia. Mostly, larger gametes are less active and formed in smaller numbers, while smaller gametes are more active and formed in relatively large numbers.

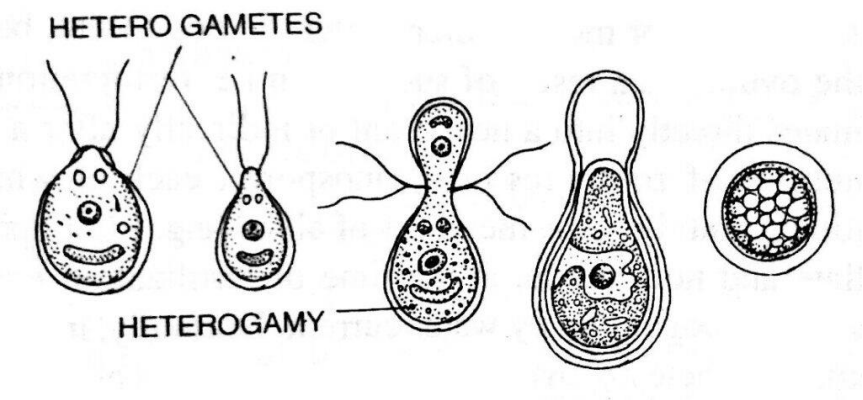

Figure: Different stages of anisogamy

The larger gametes are called macrogametes, or female gametes, and the smaller gametes are called microgametes, or male gametes, e.g., Chlamydomonas braunii, Eudorina, Pandorina, etc.

Oogamy

It is a highly advanced type of sexual reproduction in which the male gamete is quite distinct from the female gamete.

The male gametes, or microgametes, are smaller, motile, and active, while the female gametes, or macrogametes, are large, non-motile, and inactive. The male gametes are formed in the male structure called antheridia, and the female gametes are formed in the female structure called oogonia.

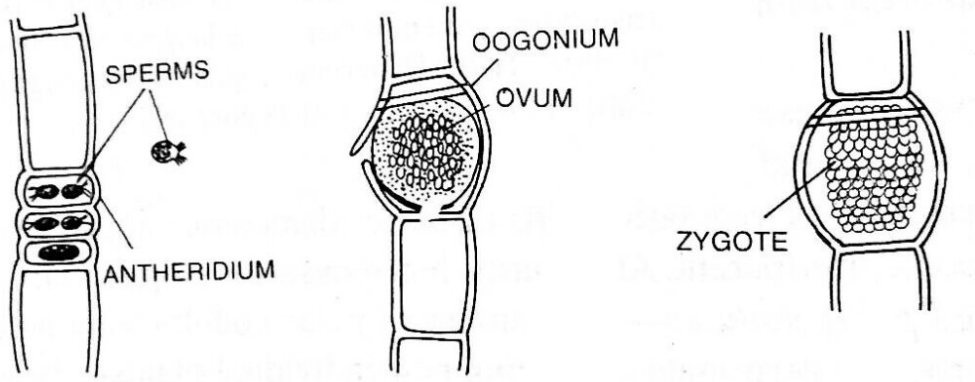

Figure: Oogamy in Oedogonium

During fertilization, the motile male gametes reach the oogonium to fertilize the egg. A diploid zygote is formed after fertilisation, e.g., Volvox, Oedogonium, Vaucheria, Chara, etc.

Autogamy

In autogamy, two nuclei of one cell or different cells of a plant fuse to form diploid nuclei. In this process, only karyogamy takes place.

There is no external gene transfer in autogamy, e.g., Diatoms.

Hologamy

Some unicellular algae, e.g., Chlamydomonas, and Dunaliella, after spending some time in a vegetative state, the unicellular thallus of opposite strains (-) and (+) behave as gametes directly. The thalli fuse to form a diploid zygote.

Hologamy is a more evolved process than autogamy because zygote formation occurs after the fusion of two plants.