

SALIENT FEATURES OF BACILLARIOPHYTA

The Bacillariophyta, commonly known as the diatoms, are ubiquitous algae of both fresh- and salt-water and of damp places including aerial habitats as, old walls, rocky cliffs, bark of trees, and damp soils. Some are submerged in water growing attached to various substrata like aquatic algae and submerged objects.

It is a large group of algae consisting of 200 genera and over 16,000 species, out of which 92 genera and about 569 species are reported from India. Most common Indian genus are *Navicula* and *Pinnularia*. They are commonly known as Diatoms. The diatoms are the most beautiful microscopic algae due to their structure and sculpturing of their walls.

Classification of Bacillariophyta:

The Bacillariophyta include the single class Bacillariophyceae which has been subdivided into two orders:

1. Centrales

Valves circular, polygonal or irregular in outline and with an ornamentation on the wall; ornamentation radial or concentric about a central point; valves never have a raphe or pseudoraphe; protoplast with many chromatophores; statospores or microspores may be formed; auxospore formation mainly by oogamy. Ex.- *Melosira*.

2. Pennales

Valves bilaterally symmetrical or asymmetrical in surface view; wall ornamentation bilateral with respect to a line; valve always with a raphe or pseudoraphe; protoplast with one or two chromatophores; statospores or microspores are never formed; auxospore formation mainly by isogamy. Ex.- *Navicula*.

Occurrence:

Diatoms are found in all possible habitats. Commonly they are found in fresh water (*Denticula tenuis*, *Navicula pupula*, *Meridion circulare*, *Cymbella ventricosa*, *Melosira variens*, *Amorpha ovalis* etc.), sea water (*Corethron*, *Biddulphia*, *Skeletonema*, *Fragilaria* etc.) and soil (*Pinnularia*, *Navicula*, *Frustulia* etc.). The terrestrial species (*Amorpha*, *Navicula*, *Pinnularia* etc.) are able to withstand desiccation for a long period. Some diatoms (*Gomphonima*,

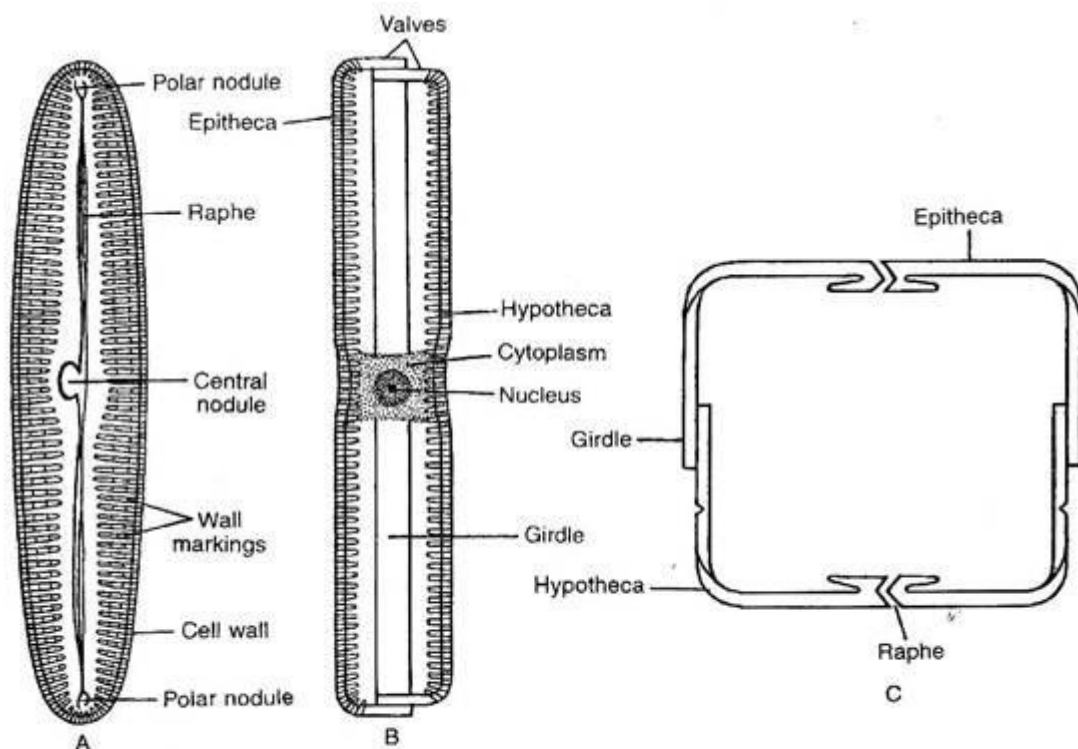
Cymbella etc.) can grow as epiphyte. *Licmophora*, a member of diatom, grows endozoically.



Ornamental shapes of different diatoms

Cell Structure:

The cell consists of cell wall and protoplast. The cells are covered by a siliceous wall, the frustule. It consists of two overlapping halves, the theca. The upper one is epitheca and lower one is hypotheca. Both the theca consist of two portions: Valve- the upper flattened top and Connecting band or cingulum- the incurved region.



Cell structure of *Pinnularia viridis* (Pennales) : A. Frustule in valve view, B. Frustule in girde view, and C. Frustule in transverse section

The common region of the connecting bands, where both the theca remain fitted together, is the girdle. When the diatoms are observed from the valve side i.e., valve side is uppermost, called the valve view, but when viewed from the connecting band, it is the girdle view. Depending on symmetry, the cells are divided into two orders: Pennales (bilaterally symmetry) and Centrales (radially symmetry).

In some pinnate diatoms (*Cybella cistula*, *Pinnularia viridis* etc.) an elongated slit is present on their valves, called raphe. The raphe is interrupted at its midpoint by thickening of the wall called central nodule. Similar thickening is also present at the ends called polar nodules. Some members like *Tabellaria fenestrata* etc. of the order Pennales, do not have raphe, called pseudoraphe. Besides raphe or pseudoraphe, the cell walls have other types of openings, called pores and locules.

The cell wall is mainly made up of pectic substances, impregnated with silica. The content of silica varies from 1% (*Phaeodactylum tricornutum*) to about 50% on the basis of dry weight of the cell. The entire content present inside the cell wall is the protoplast. The cell membrane encloses a large central vacuole surrounded by cytoplasm. The cytoplasm contains single nucleus, mitochondria, golgi bodies and chloroplasts. The chloroplasts may be of different shapes like stellate, H-shaped, discoid etc. In some species the chloroplasts contain pyrenoids. Depending on the mode of nutrition they may be photosynthetic autotrophs or photosynthetic symbionts or heterotrophs.

The photosynthetic pigments are chlorophyll a, c₁ and c₂, β-carotene, fucoxanthin, diatoxanthin and diadinoxanthin. The latter two are present in small quantity. (The golden-brown colour of diatom cells is due to the presence of xanthophylls like fucoxanthin, diatoxanthin and diadinoxanthin. The term diatomin is used for the mixture of chlorophyll and carotenoids, particularly carotene and several brown xanthophylls pigments.) The reserve food of diatoms is chrysolaminarin and oil droplets (they do not store in the form of starch).

Movement:

All diatoms with raphe are motile. Most of the members of the order Pennales contain raphe and perform gliding movement. The gliding movement

is caused by the circulation of cytoplasm within the raphe by the release of mucilage. The rate of movement varies from 0.2-25 $\mu\text{m}/\text{sec}$. The locomotion is affected by temperature, light etc.

Reproduction:

Diatoms reproduce vegetatively by cell division. During the process the protoplast of the mother cell swells up and the valves are slightly pushed apart. The nucleus now divides by mitosis into two daughter nuclei. Cytoplasm undergoes cleavage in such a way that each valve receives a daughter nucleus and a portion of cytoplasm. Then a new valve is secreted outside the daughter protoplast within each old valve.

In this way two daughter cells are formed. These two daughter cells are unequal in size and one of the valves belongs to the parent cell and the other is newly formed. In the subsequent cell divisions, the sizes of the daughter cells successively become smaller and smaller. When a certain definite minimum size is reached, a special mode of reproduction takes place by the formation of a special large rejuvenation takes place by the formation of a special large rejuvenating cell called auxospore such that the original size of the cell is regained.

In Centric diatoms, the protoplast becomes about three times bulky by the absorption of water and the valves are widely pushed apart. This increased bulk of protoplast now secretes two overlapping valves and the entire structure thus formed is known as an auxospore. The auxospore divides vegetatively and gives rise to vegetative cells. In Pennate diatoms, the auxospore is formed from the zygote which is the product of fusion of gametes produced by a single of two vegetative cells.

Two conjugating diatoms come to lie close together and become enveloped by a common mucilaginous sheath. The diploid nucleus of each now divides by meiosis to form four haploid nuclei of which a single or two haploid daughter nuclei persist in each vegetative cell. Cytoplasm now collects around each of these daughter nuclei and in this way each vegetative cell gives rise to a single or two gametes. The gametes fuse sexually and give rise to a single or two zygotes and function as auxospores. Sometimes, two gametes are produced from a single vegetative cell, which fuse together to form zygote and auxospore.