# TY B.Sc. Botany – Phycology Notes

## Unit 1: An Introduction to Algae and Unit 2: Life Cycle of Chara and Sargassum

Easy, detailed examination-oriented notes for Third Year B.Sc. students.

## UNIT 1 – AN INTRODUCTION TO ALGAE

### 1.1 Definition and General Characters

Algae are mainly simple, chlorophyll-containing, photosynthetic organisms that are usually aquatic. Their plant body is called a **thallus** because it is not differentiated into true root, stem and leaves. Most algae prepare their own food by photosynthesis and release oxygen.

- Mostly aquatic; found in freshwater, marine water and moist places.
- Body is generally a thallus and lacks true roots, stems, leaves and vascular tissues.
- Chlorophyll is present, but accessory pigments differ among groups.
- Cell wall is commonly cellulose-based, although its composition varies in different algal groups.
- Reserve food differs: starch in many green algae, laminarin and mannitol in brown algae, and floridean starch in red algae.
- Reproduction may be vegetative, asexual or sexual.
- Life cycles may be haplontic, diplontic or diplohaplontic.
- Size ranges from microscopic unicellular forms to very large seaweeds.

### 1.2 Habit and Habitat

Algae show great diversity in their **habit** (form of growth) and **habitat** (place where they live).

- Unicellular: Chlamydomonas, Chlorella.
- Colonial: Volvox, Hydrodictyon.
- Filamentous: Spirogyra, Ulothrix.
- Siphonaceous/coenocytic: Vaucheria, Caulerpa.
- Large multicellular seaweeds: Sargassum, Laminaria.
- Freshwater habitats: ponds, lakes, streams and wet soil.
- Marine habitats: rocky shores, tidal pools and oceans.
- Subaerial habitats: moist rocks, tree bark and soil surfaces.
- Symbiotic habitats: some algae occur with fungi in lichens or with animals/microorganisms.

### 1.3 Organization of Thallus

The algal thallus may be extremely simple or highly organized. Common forms are:

- Unicellular motile – Chlamydomonas.
- Unicellular non-motile – Chlorella.
- Colonial – Volvox.
- Unbranched filament – Spirogyra, Ulothrix.

- Branched filament – Cladophora.
- Heterotrichous – Stigeoclonium.
- Siphonaceous/coenocytic – Vaucheria and Caulerpa; the body has multinucleate cytoplasm without regular cross walls.
- Parenchymatous/pseudoparenchymatous forms – common in larger seaweeds such as Sargassum.

## 1.4 Similarities and Differences with Fungi and Bryophytes

Algae, fungi and bryophytes are traditionally studied together because they are relatively simple organisms compared with vascular plants. However, they differ fundamentally in nutrition, pigments and body organization.

## 1.5 Reproduction

Algae reproduce by **vegetative, asexual and sexual methods**.

- Vegetative reproduction: fragmentation, cell division or special propagules. Example: Spirogyra commonly reproduces by fragmentation.
- Asexual reproduction: spores are produced without fusion of gametes. Examples include zoospores, aplanospores, autospores and other specialized spores.
- Sexual reproduction: fusion of male and female gametes occurs. It may be isogamous (similar gametes), anisogamous (unequal gametes) or oogamous (small motile male gamete and large non-motile egg).
- Sexual reproduction produces a zygote, which may undergo meiosis later depending on the life cycle.

## 1.6 Life Cycle Patterns

A life cycle describes the sequence of haploid (n) and diploid (2n) stages and the position of meiosis and fertilization.

- **Haplontic:** The main plant body is haploid (n). The zygote is usually the only diploid stage and undergoes meiosis. Example: Spirogyra.
- **Diplontic:** The main plant body is diploid (2n). Gametes are haploid and meiosis occurs during gamete formation. Example: Fucus (a brown alga).
- **Diplohaplontic:** Both haploid gametophyte and diploid sporophyte generations are present. They alternate with each other. Examples: Ulva and many other algae.

## 1.7 Outline Classification of Algae – F. E. Fritsch (1945)

F. E. Fritsch proposed a classical classification of algae based mainly on pigments, reserve food, flagella, thallus organization and reproduction. His scheme recognized **11 classes**.

- Chlorophyceae – green algae; examples: Chlamydomonas, Spirogyra, Volvox.
- Xanthophyceae – yellow-green algae; example: Vaucheria.
- Chrysophyceae – golden algae; example: Synura.
- Bacillariophyceae – diatoms; examples: Navicula, Pinnularia.
- Cryptophyceae – cryptomonads; example: Cryptomonas.
- Dinophyceae – dinoflagellates; example: Ceratium.
- Chloromonadineae – chloromonads; example: Vacuolaria.
- Euglenineae – euglenoids; example: Euglena.
- Phaeophyceae – brown algae; examples: Sargassum, Laminaria.
- Rhodophyceae – red algae; examples: Polysiphonia, Gelidium.
- Myxophyceae (Cyanophyceae in older treatments) – blue-green algae; examples: Nostoc, Anabaena.

# UNIT 1 – QUICK COMPARISON

| Feature | Algae | Fungi | Bryophytes |
|---|---|---|---|
| Nutrition | Mostly autotrophic; photosynthetic | Heterotrophic; absorptive | Autotrophic; photosynthetic |
| Main body | Thallus | Mycelium/hyphae | Gametophyte differentiated into simple plant body |
| Chlorophyll | Present | Absent | Present |
| Cell wall | Usually cellulose or group-specific materials | Mainly chitin | Cellulose and other materials |
| Habitat | Mostly aquatic | Mostly terrestrial | Mostly moist terrestrial |
| Vascular tissue | Absent | Absent | Absent |
| Reproduction | Vegetative, asexual, sexual | Vegetative, asexual, sexual | Vegetative and sexual; alternation of generations |

**Exam tip:** Remember the three basic life-cycle words: Haplontic = haploid plant body; Diplontic = diploid plant body; Diplohaplontic = both generations present.

# UNIT 2 – LIFE CYCLE OF CHARA

## 2.1 Systematic Position

**Kingdom:** Plantae **Group:** Green algae **Class:** Charophyceae (modern treatments may place Charales within Charophyta) **Order:** Charales **Genus:** Chara

## 2.2 Occurrence

Chara is commonly found in freshwater ponds, lakes, ditches and slow-moving water. It often grows attached to the bottom in shallow water. Because its plant body resembles a small flowering plant, it is sometimes called **stonewort** when encrusted with calcium carbonate.

## 2.3 Morphology

The plant body is multicellular, green and branched. It consists of a main axis with distinct nodes and internodes. At the nodes, whorls of branchlets arise. Rhizoids occur at the lower region and help in attachment. The internodes are elongated and may be large single cells; nodes are multicellular.

## Important structures

- **Rhizoids:** anchorage to the substratum and absorption of limited nutrients.
- **Nodes:** regions from which branchlets arise.
- **Internodes:** elongated portions between two nodes.
- **Branchlets:** arranged in whorls and give the plant its characteristic appearance.
- **Sex organs:** Chara is usually monoecious; antheridia and oogonia occur on the same plant, generally at the nodes.

## 2.4 Reproduction

**Vegetative:** fragmentation and specialized structures may contribute to vegetative propagation.
**Sexual:** reproduction is oogamous. The male sex organ is the **globule (antheridium)** and the female sex organ is the **nucule (oogonium)**.

## 2.5 Sexual Reproduction and Fertilization

- The globule produces numerous antherozoids (male gametes).
- The nucule contains a single egg surrounded by protective cells.
- At maturity, antherozoids are released into water.
- One antherozoid fuses with the egg to form a diploid zygote (oospore).
- The oospore develops a resistant wall and passes through a resting period.
- During germination, meiosis occurs, restoring the haploid condition.

## 2.6 Life Cycle of Chara

The visible Chara plant is **haploid (n)**. The zygote/oospore is the only major diploid phase. Therefore Chara shows a **haplontic life cycle**.

Simple sequence: **Haploid Chara (n)** → **antheridium + oogonium** → **fertilization** → **zygote/oospore (2n)** → **meiosis during germination** → **haploid stage** → **new Chara.**

# UNIT 2 – LIFE CYCLE OF SARGASSUM

## 2.7 Systematic Position

**Kingdom:** Plantae **Phylum/Division:** Phaeophyta (classical treatment) **Class:** Phaeophyceae **Order:** Fucales **Genus:** Sargassum

## 2.8 Occurrence

Sargassum is a marine brown alga. It occurs mainly in shallow coastal seas and is attached to rocks or other firm substrata by a holdfast. Some species form large floating masses in the sea.

## 2.9 Morphology

The plant body is a large, brown, multicellular thallus. It is differentiated into a holdfast, a stem-like axis and leaf-like blades. Air bladders (pneumatocysts) occur in many species and help branches remain near the water surface.

- **Holdfast:** anchors the plant to the substratum; it is not a true root.
- **Stipe/axis:** supports branches and blades; it is not a true stem.
- **Leaf-like blades:** photosynthetic structures.
- **Air bladders:** gas-filled structures that provide buoyancy in many species.
- **Receptacles:** fertile regions containing conceptacles in which sex organs occur.

## 2.10 Reproduction

Sargassum reproduces mainly by sexual reproduction. It is **oogamous**. Male and female reproductive structures occur in conceptacles. Species are commonly dioecious, with male and female reproductive structures on separate plants.

## 2.11 Sexual Reproduction

- Male conceptacles contain antheridia that produce numerous biflagellate antherozoids.
- Female conceptacles contain oogonia. Each oogonium produces an egg.
- Eggs are released and fertilized by motile antherozoids in seawater.
- Fertilization produces a diploid zygote.
- The zygote develops directly into a young diploid Sargassum plant.

## 2.12 Life Cycle of Sargassum

The adult Sargassum plant is **diploid (2n)**. Meiosis occurs during the formation of gametes, and the gametes are haploid. There is no free-living multicellular gametophyte. Hence Sargassum shows a **diplontic life cycle**.

Simple sequence: **Diploid Sargassum (2n)** → **meiosis during gamete formation** → **haploid gametes** → **fertilization** → **diploid zygote (2n)** → **young Sargassum** → **adult Sargassum.**

# CHARA vs SARGASSUM – EXAM REVISION

| Feature | Chara | Sargassum |
|---|---|---|
| Group | Green alga / Charophyte | Brown alga |
| Habitat | Freshwater | Marine |
| Plant body | Green, branched, node-internode organization | Large brown thallus with holdfast, axis and blades |
| Sexual reproduction | Oogamous | Oogamous |
| Sex organs | Globule and nucule | Antheridia and oogonia in conceptacles |
| Dominant plant | Haploid | Diploid |
| Life cycle | Haplontic | Diplontic |
| Meiosis | During oospore germination | During gamete formation |

## Important short-answer questions

- Define algae and write any five general characters.
- Explain the major types of algal thallus organization with examples.
- Differentiate algae, fungi and bryophytes.
- Explain haplontic, diplontic and diplohaplontic life cycles.
- Write the outline classification of algae according to F. E. Fritsch (1945) up to classes with examples.
- Give the systematic position, occurrence and morphology of Chara.
- Describe sexual reproduction and life cycle of Chara.
- Give the systematic position, occurrence and morphology of Sargassum.
- Describe sexual reproduction and life cycle of Sargassum.
- Differentiate the life cycles of Chara and Sargassum.

**Memory trick:** CHARA = freshwater + haploid plant + haplontic. SARGASSUM = marine + diploid plant + diplontic.

*Note: Fritsch's 1945 classification is a classical historical classification. Modern algal taxonomy uses molecular and phylogenetic evidence and may use different ranks.*