

Chapter 1. Algae

1. Introduction

Algae are **simple, photosynthetic organisms** that live mainly in **aquatic environments** (marine and freshwater).

They are very important in **geology, ecology, and Earth history** because they contributed to:

- Oxygen production
- Formation of sediments (limestone, diatomite)
- Fossil records

2. Definition of algae

Algae are **autotrophic, chlorophyll-containing organisms**, mostly aquatic, ranging from **unicellular to multicellular forms**, and capable of photosynthesis.

3. General Characteristics of Algae

- Mostly **aquatic** (freshwater & marine)
- **Photosynthetic** (contain chlorophyll and other pigments)
- Body called **thallus** (no true organs)
- Can be:
 - **Unicellular** (e.g., *Chlamydomonas*)
 - **Colonial** (e.g., *Volvox*)
 - **Multicellular** (e.g., seaweeds)
- Reproduce **asexually and sexually**
- Important **primary producers**

4. Classification of Algae (Main Groups)

4.1 Green Algae (Chlorophyta)

- Pigments: **Chlorophyll a and b**
- Reserve food: **Starch**
- Cell wall: **Cellulose**
- Habitat: freshwater & marine
- Examples: *Chlamydomonas*, *Spirogyra*, *Ulva*

□ **Geological importance:** ancestors of land plants

The classification of algae is based on several factors such as pigment composition, storage products, cellular structure, and habitat. Algae are divided into several major groups, or **phyla**, which are further subdivided based on their characteristics. Here is an overview of the main divisions in the classification of algae:

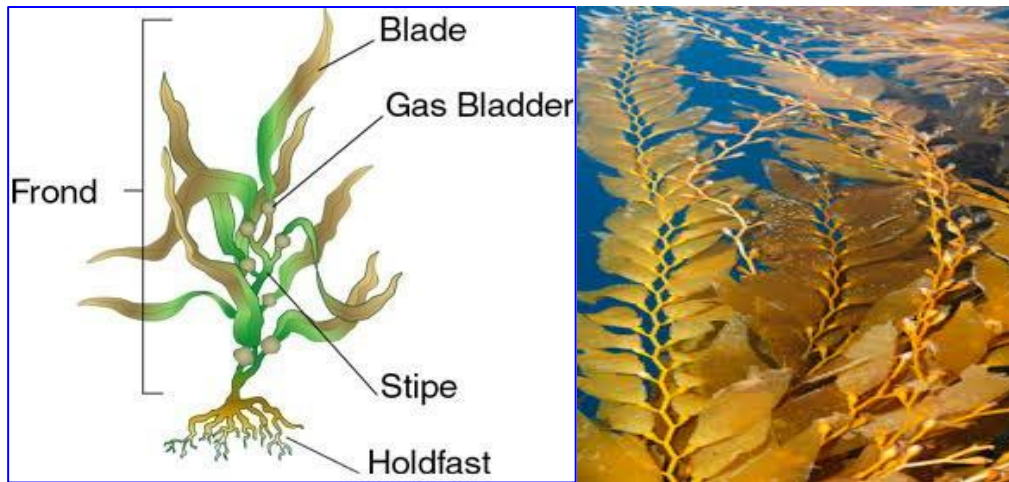
1. Chlorophyta (Green Algae)

- **Pigments:** Contain chlorophyll a and b, giving them a green color.
- **Storage Products:** Store starch.
- **Structure:** Can be unicellular, multicellular, or colonial.
- **Habitat:** Primarily freshwater, but also marine and terrestrial.
- **Examples:** *Chlamydomonas*, *Spirogyra*, *Ulva*
- **Reproduction:** Both asexual (via spores or fragmentation) and sexual (via gametes).
- **Geological importance:** ancestors of land plants



2. Phaeophyta (Brown Algae)

- **Pigments:** Contain chlorophyll a and c, along with the brown pigment fucoxanthin.
- **Storage Products:** Store laminarin and mannitol.
- **Structure:** Mostly multicellular, with complex structures such as holdfasts, stipes, and blades.
- **Habitat:** Mostly marine, especially in colder waters.
- **Examples:** *Macrocystis* (kelp), *Fucus*.
- **Reproduction:** Both asexual (via spores) and sexual (via gametes).



3. Rhodophyta (Red Algae)

- **Pigments:** Contain chlorophyll a and the red pigment phycoerythrin, which gives them a red color.
- **Storage Products:** Store starch, but in a different form than green algae.
- **Structure:** Mostly multicellular, with some species being macroscopic and others microscopic.
- **Habitat:** Primarily marine, often in deeper waters where light penetration is lower.
- **Examples:** *Porphyra* (nori), *Corallina* (coralline algae).
- **Reproduction:** Both asexual and sexual; complex life cycles involving alternation of generations.



• *Porphyra* (nori)



Corallina (coralline algae)

4. Chrysophyta (Golden Algae)

- **Pigments:** Contain chlorophyll a and c, with golden-yellow pigments (xanthophylls).
- **Storage Products:** Store oil and starch.
- **Structure:** Typically unicellular or colonial.
- **Habitat:** Freshwater environments, but can also be found in marine habitats.

- **Examples:** *Dinobryon*, *Vaucheria*.
- **Reproduction:** Asexual (via binary fission) and sexual (via gametes).

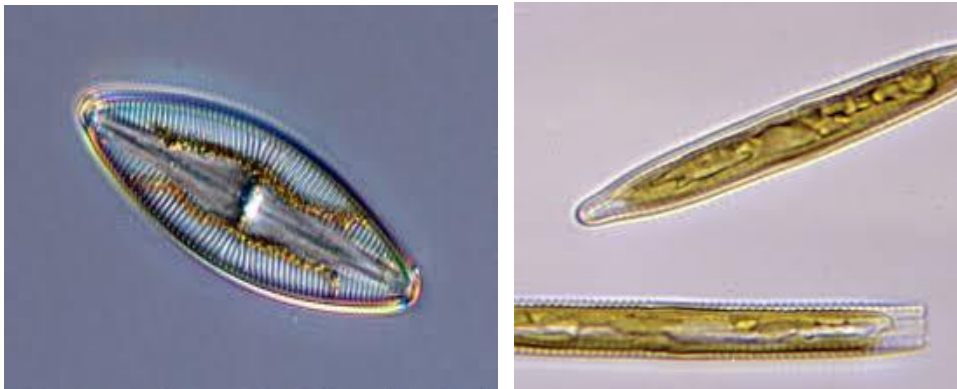


□ Dinobryon

Vaucheria

5. Bacillariophyta (Diatoms)

- **Pigments:** Contain chlorophyll a and c, along with carotenoids.
- **Storage Products:** Store oil.
- **Structure:** Unicellular, with a unique silica cell wall that forms intricate patterns.
- **Habitat:** Found in both marine and freshwater environments.
- **Examples:** *Navicula*, *Synedra*.
- **Reproduction:** Asexual (via binary fission) and sexual.



Navicula

Synedra.

6. Cyanobacteria (Blue-green Algae)

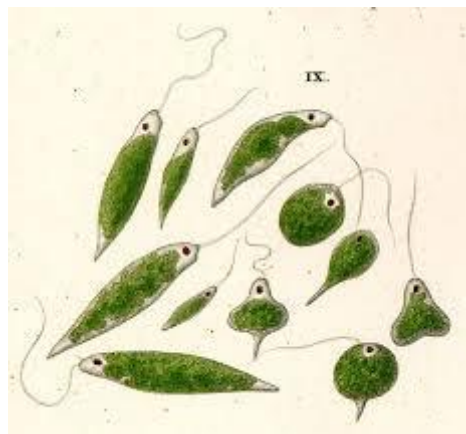
- **Pigments:** Contain chlorophyll a and the blue pigment phycocyanin, which gives them a blue-green color.
- **Storage Products:** Store glycogen.
- **Structure:** Unicellular, colonial, or filamentous.

- **Habitat:** Found in freshwater, marine, and terrestrial environments.
- **Examples:** *Anabaena*, *Spirulina*.
- **Reproduction:** Asexual (via binary fission) and some can also form spores (akin to sexual reproduction).



7. Euglenophyta (Euglenoids)

- **Pigments:** Contain chlorophyll a and b, along with carotenoids.
- **Storage Products:** Store starch.
- **Structure:** Unicellular, often with a flagellum for movement.
- **Habitat:** Primarily freshwater, but some are found in marine environments.
- **Examples:** *Euglena*, *Peranema*.
- **Reproduction:** Asexual (via binary fission).



4. Classification of algae

Algae can be classified into **prokaryotic** and **eukaryotic** based on the structure of their cells, specifically whether they have a defined nucleus and membrane-bound organelles.

1. Prokaryotic Algae (Cyanobacteria - Blue-green Algae)

- **Cell Structure:** These are **prokaryotic** organisms, meaning they do not have a membrane-bound nucleus or other membrane-bound organelles (like mitochondria or chloroplasts).
- **Photosynthetic Pigments:** They contain **chlorophyll a** and other pigments like **phycocyanin** and **phycoerythrin**, which give them their characteristic blue-green color.
- **Reproduction:** Cyanobacteria reproduce primarily through **binary fission**, a form of asexual reproduction. They can also form **spores** or specialized cells like **akinetes** for survival in harsh conditions.
- **Habitat:** Found in freshwater, marine environments, and even on land (in moist areas). Some cyanobacteria can form harmful algal blooms (e.g., in freshwater lakes).

2. Eukaryotic Algae

Eukaryotic algae have more complex cells with a membrane-bound nucleus and organelles like **chloroplasts** (which carry out photosynthesis). They are the more common "true" algae we think of.

Groups of Eukaryotic Algae:

- **Green Algae (Chlorophyta)**
- **Brown Algae (Phaeophyta)**
- **Red Algae (Rhodophyta)**
- **Diatoms (Bacillariophyta):**
- **Golden Algae (Chrysophyta):**

Key Differences between Prokaryotic and Eukaryotic Algae:

- **Nucleus:**
 - **Prokaryotic algae** (cyanobacteria) lack a membrane-bound nucleus.
 - **Eukaryotic algae** have a membrane-bound nucleus and other organelles.
- **Reproduction:**
 - **Prokaryotic algae** (cyanobacteria) reproduce mainly through **binary fission** (asexual).
 - **Eukaryotic algae** reproduce through both **asexual** methods (e.g., binary fission, spores) and **sexual** reproduction (via gametes).

- **Complexity:**
 - **Prokaryotic algae** are generally simpler in structure.
 - **Eukaryotic algae** have more complex structures, often with specialized organs (e.g., holdfasts, blades in brown algae).