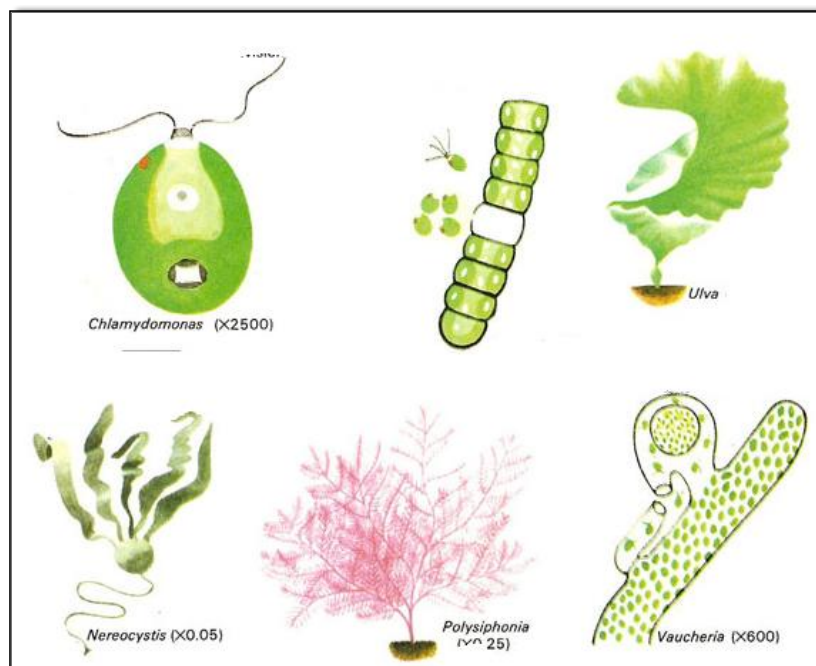


ALGAE (*L. Seaweed*)



SALIENT FEATURES:

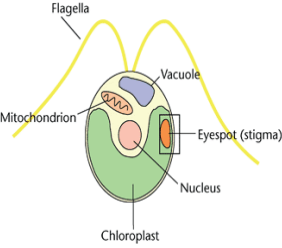

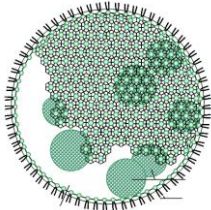
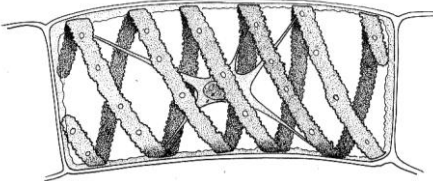
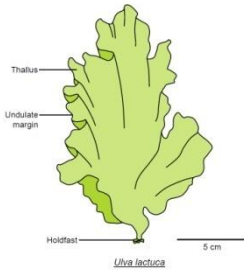

1. Algae are autotrophic organisms and they have chlorophyll.
2. They are O₂ producing photosynthetic organisms.
3. In algae the plant body shows no differentiation into root, stem or leaf or true tissues. Such a plant body is called thallus.
4. They do not have vascular tissues.
5. The sex organs of this group of kingdom plantae are not surrounded by a layer of sterile cells.
6. Embryo formation is absent.

HABITAT:

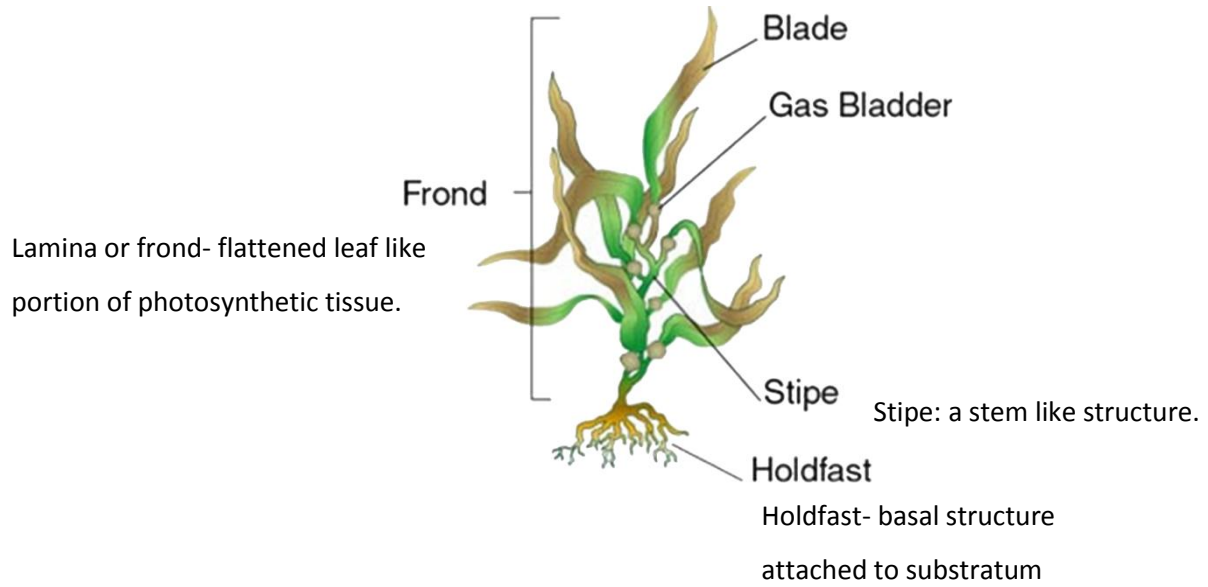
1. Most of the algae are aquatic either fresh water or marine. Very few are terrestrial.
2. Some species of algae and fungi are found in association with each other and they are called Lichens.
3. The free floating and free swimming minute algae are known as phytoplanktons.
4. Species that are found attached to the bottom of shallow water along the edges of seas and lakes are called Benthic.
5. A few genera grow even in extreme condition like thermal springs (thermal algae), glaciers and snow (cryophytes).

APPEARANCE:

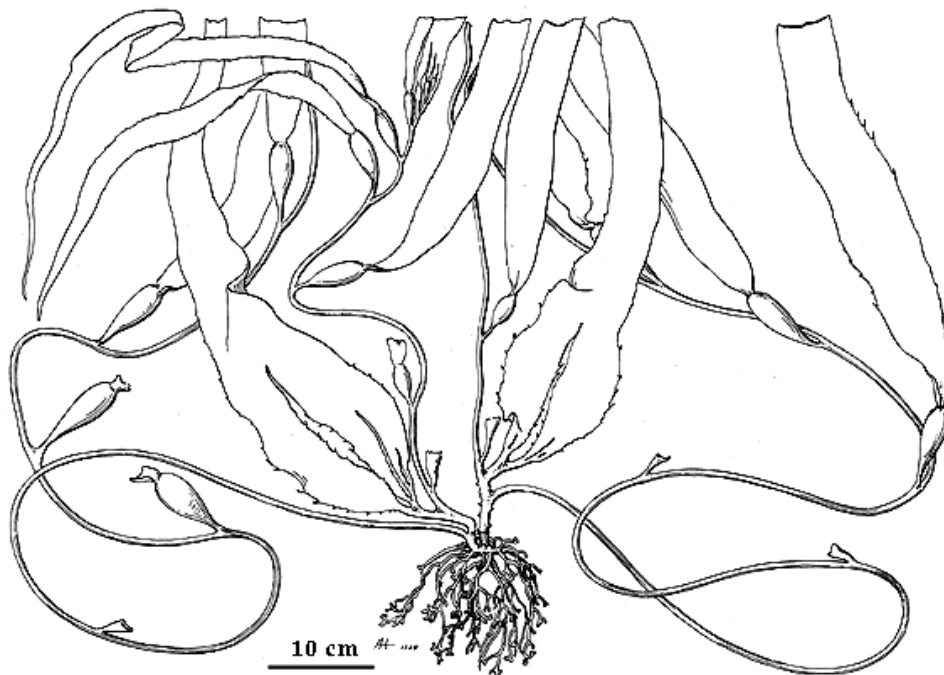
1. The thalli of algae exhibit a great range of variation in structure and organization.
2. It ranges from microscopic unicellular forms to giant seaweeds like *Macrocystis* which measures up to 100 meters long.

Forms	Examples	
Unicellular motile	<p><i>Chlamydomonas</i></p> 	
Unicellular non motile	<p><i>Chlorella</i></p> 	
Colonial	<p><i>Volvox</i></p> 	
Filamentous	<p><i>Spirogyra, Ulothrix</i></p> 	
Branched filamentous (parenchymatous)	<p><i>Ulva,</i></p> 	<p><i>Sargasum</i></p> 

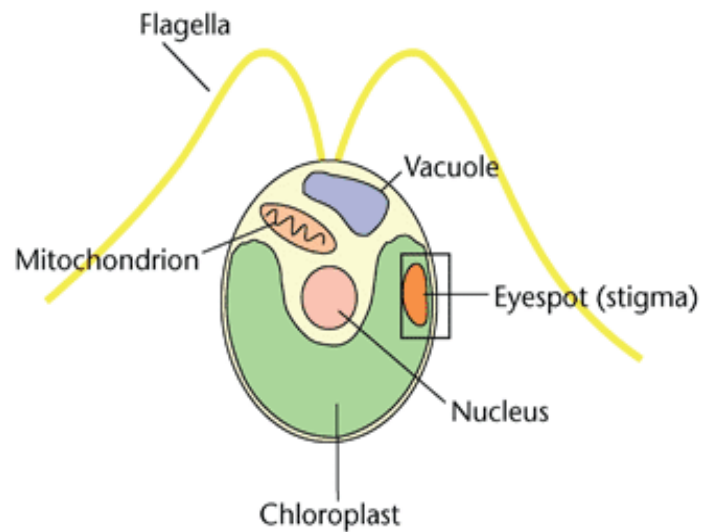
3. The branched filamentous algae are attached to the substratum and are differentiated into three parts.



4. A few of the marine forms such as kelps, form massive plant bodies.
Eg. *Macrocystis*



CELL STRUCTURE: EUKARYOTIC



Cell wall	<ul style="list-style-type: none"> The cell wall is made up of cellulose and pectin.
Flagella	<ul style="list-style-type: none"> Flagella are organs of locomotion that occur in a majority of algal classes. There are two types of flagella namely whiplash (Acronematic) and tinsel (pantonematic). Red -algae (Rhodophyta) lack flagella.
Pyrenoid	<ul style="list-style-type: none"> In each chloroplast one or few spherical bodies called pyrenoids are present. They are the centres of starch formation.
Eye spot (Stigma)	<ul style="list-style-type: none"> Light sensitive structure.(not present in all)
Pigmentation	<ul style="list-style-type: none"> Three types of Photosynthetic pigments are seen in algae. They are 1. Chlorophylls (a,b,c,d,e) 2. Carotenoids 3. Biliproteins. While chlorophyll a is universal in all algal classes, chlorophyll b,c,d,e are restricted to some classes of algae. The water soluble biliproteins called phycoerythrin (red) and phycocyanin (blue) occur generally in the Rhodophyceae and Cyanophyceae
Reserve food	<ul style="list-style-type: none"> Algae are autotrophic in their mode of nutrition. The carbohydrate reserves of algae are various forms of starch in different classes of Algae

REPRODUCTION

- Three common methods of reproduction found in algae are
1. Vegetative 2. Asexual and 3. Sexual
- **Vegetative reproduction:** It can take place by following ways.
 - a) Fission: c) Tubers
 - b) Fragmentation d) Budding.
- **Asexual reproduction:** It takes place by means of different kinds of spores.
 - a) Zoospores :flagellated and motile
 - b) Aplanospores : thin walled and non motile
 - c) Akinetes. Akinetes are thick walled and non motile spores
- **Sexual Reproduction:**
- Sexual reproduction takes place through fusion of two gametes. Depends on types of gametes it can be of three types.
- **Isogamous:** When gametes are flagellated and similar in size (as in *Chlamydomonas*) or non-flagellated (non-motile) but similar in size (as in *Spirogyra*).
- **Anisogamous:** Fusion of two gametes dissimilar in size, as in some species of *Chlamydomonas* is termed as **anisogamous**.
- **Oogamous:** Fusion between one large, non-motile (static) female gamete and a smaller, motile male gamete is termed oogamous, e.g., *Volvox*, *Fucus*.

ECONOMIC IMPORTANCE

- Algae are useful to man in a variety of ways.
1. **Photosynthesis:** At least a half of the total carbon dioxide fixation on earth is carried out by algae through photosynthesis.
 2. **Oxygen producer:** Being photosynthetic they increase the level of dissolved oxygen in their immediate environment.
 3. **Producer in food chain:** They are of paramount importance as primary producers of energy-rich compounds which form the basis of the food cycles of all aquatic animals.
 4. **As a food:** Many species of *Porphyra*, *Laminaria* and *Sargassum* are among the 70 species of marine algae used as food.
 5. **In industries:**
 - a) **Hydrocolloids (phycocolloids):** Certain marine brown and red algae produce large amounts of hydrocolloids (water holding substances), e.g., **algin** (brown algae) and **carrageen** (red algae) are used commercially. Algin is used as emulsifier in ice creams, tooth pastes and cosmetics.
 - b) **Agar**, one of the commercial products obtained from *Gelidium* and *Gracilaria* are used to grow microbes and in preparations of ice-creams and jellies.
 - c) **Iodine:** It is obtained from kelps (brown algae) especially from species of *Laminaria*.
 6. **Algae in space travel:** *Chlorella* and *Spirulina* are unicellular algae, rich in proteins and are used as food supplements even by space travellers.

CLASSIFICATION

F.E. Fritsch (1944-45) classified algae into 11 classes in his book “**Structure and Reproduction of Algae**” based on the following characteristics.


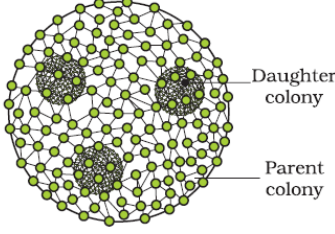
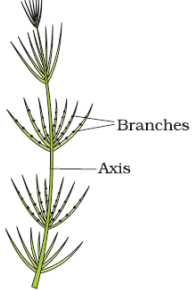
1. Pigmentation
2. Reserve food
3. Flagellar arrangement
4. Thallus organization
5. Reproduction.

The 11 classes of algae are:

1. Chlorophyceae
2. Xanthophyceae
3. Chrysophyceae
4. Bacillariophyceae
5. Cryptophyceae
6. Dinophyceae
7. Chloromonadineae
8. Euglenophyceae
9. Phaeophyceae
10. Rhodophyceae and
11. Myxophyceae

Chlorophyceae (Green algae)

- Habitat:** Fresh water, algae brackish water, salt water.
- Forms:** The plant body may be unicellular, colonial or filamentous.

Unicellular: <i>Chlamydomonas</i>	Colonial: <i>Volvox</i>	Filamentous: <i>Chara</i>
		

3. Pigmentation:

- They are usually grass green due to the dominance of pigments chlorophyll *a* and *b*.
- The pigments are localised in definite chloroplasts.
- The chloroplasts may be discoid, plate-like, reticulate, cup-shaped, spiral or ribbon-shaped in different species.

4. Reserve food:

- Most of the members have one or more storage bodies called pyrenoids located in the chloroplasts.
- Pyrenoids contain protein besides starch. Some algae may store food in the form of oil droplets.

5. Cell wall

- Green algae usually have a rigid cell wall made of an inner layer of cellulose and an outer layer of pectose.

6. Flagella: 2-8, equal.

7. Reproduction :

- a. Vegetative reproduction usually takes place by fragmentation.
- b. Asexual reproduction is by flagellated zoospores produced in zoosporangia.
- c. The sexual reproduction shows considerable variation in the type and formation of sex cells and it may be isogamous, anisogamous or oogamous.

8. Examples:

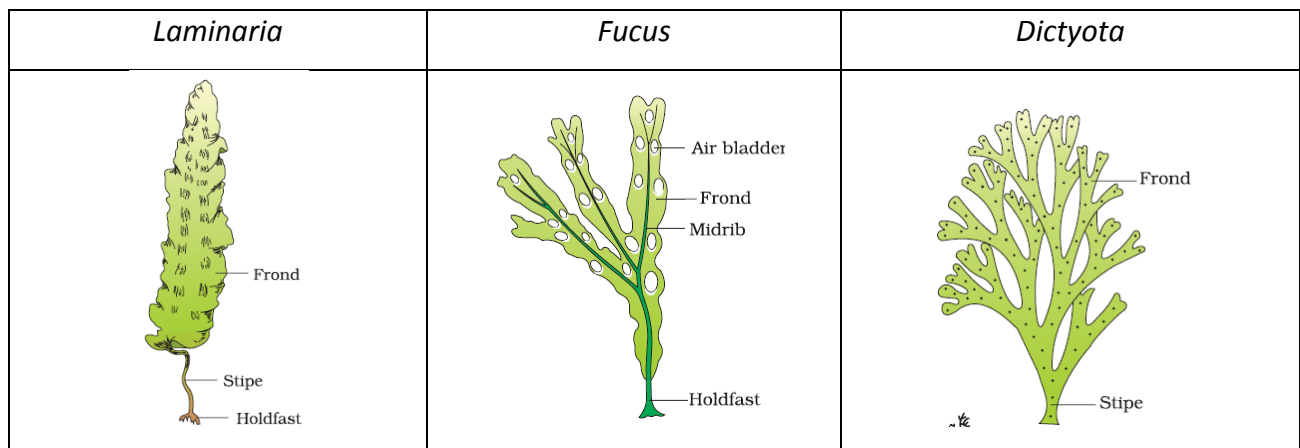
Some commonly found green algae are: *Chlamydomonas*, *Volvox*, *Ulothrix*, *Spirogyra* and *Chara*.

Phaeophyceae (Brown algae)

1. Habitat: Fresh water (rare) brackish water salt water.

2. Forms:

- They show great variation in size and form. They range from simple branched, filamentous forms (*Ectocarpus*) to profusely branched forms as represented by kelps, which may reach a height of 100 metres.
- The plant body is usually attached to the substratum by a holdfast, and has a stalk, the stipe and leaf like photosynthetic organ – the frond.



3. Pigmentation:

- They possess chlorophyll a, c, carotenoids and xanthophylls.
- They vary in colour from olive green to various shades of brown depending upon the amount of the xanthophyll pigment, **fucoxanthin** present in them.

4. Reserve food:

- Food is stored as complex carbohydrates, which may be in the form of laminarin or mannitol

5. Cell wall :

- The cells have a cellulosic wall usually covered on the outside by a gelatinous coating of algin

6. Flagella:

7. Reproduction :

- a. Vegetative reproduction takes place by fragmentation.
- b. Asexual reproduction in most brown algae is by biflagellate zoospores that are pear-shaped and have two unequal laterally attached flagella.
- c. Sexual reproduction may be isogamous, anisogamous or oogamous. Union of gametes may take place in water or within the oogonium (oogamous species). The gametes are pyriform (pear-shaped) and bear two laterally attached flagella.

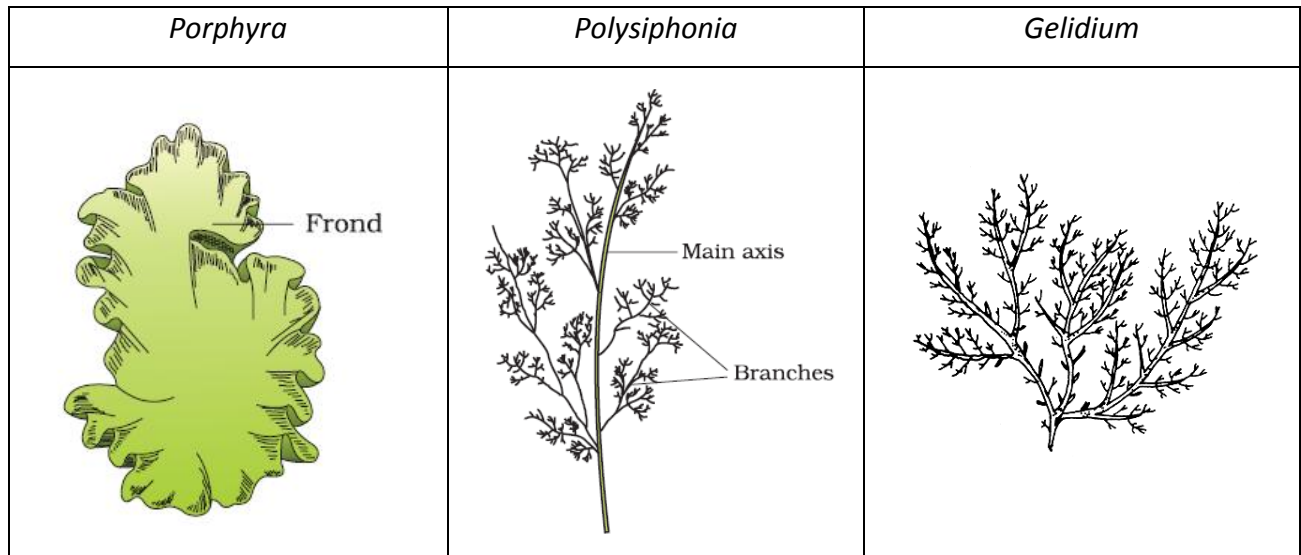
8. Examples: The common forms are *Ectocarpus*, *Dictyota*, *Laminaria*, *Sargassum* and *Fucus*.

Rhodophyceae (Red algae)

1. Habitat:

- Majority of the red algae are marine with greater concentrations found in the warmer areas.
- They occur in both well-lighted regions close to the surface of water and also at great depths in oceans where relatively little light penetrates.

2. Forms: Most of the red algae are multicellular. Some of them have complex body organisation



3. Pigmentation:

- They possess chlorophyll a, d, r- phycoerythrin (red pigment)

4. Reserve food:

- The food is stored as floridean starch which is very similar to amylopectin and glycogen in structure

5. Cell wall: cellulosic cell wall is present.

6. Flagella: Absent

7. Reproduction :

- The red algae usually reproduce vegetatively by fragmentation.
- They reproduce asexually by non-motile spores and sexually by non-motile gametes.
- Sexual reproduction is oogamous and accompanied by complex post fertilisation developments.

8. Examples: The common members are: *Polysiphonia*, *Porphyra*, *Gracilaria* and *Gelidium*.

Comparative study between Chlorophyceae, Phaeophyceae and Rhodophyceae

Classes	Common Name	Major Pigments	Stored Food	Cell Wall	Flagellar Number and Position of Insertions	Habitat
Chlorophyceae	Green algae	Chlorophyll <i>a, b</i>	Starch	Cellulose	2-8, equal, apical	Fresh water, brackish water, salt water
Phaeophyceae	Brown algae	Chlorophyll <i>a, c</i> , fucoxanthin	Mannitol, laminarin	Cellulose and algin	2, unequal, lateral	Fresh water (rare) brackish water, salt water
Rhodophyceae	Red algae	Chlorophyll <i>a, d</i> , phycoerythrin	Floridean starch	Cellulose	Absent	Fresh water (some), brackish water, salt water (most)