Sexual repro is of three types.

(a) Isogamous - *Chlamydomona debaryanum, Ulothrix, Ectocarpus*
(b) Anisogamous - *Chlamydomonas braunii*
(c) Oogamous - *Chlamydomonas coccifera, Sargassum, Volvox*

Note : (1) ***Chlamydomanas*** exhibits complete evolution of sexual reproduction.
Isogamous - Simplest
Oogamous - Advanced
(2) ***Ulothrix*** exhibits origin of sexual reproduction

The classification of algae is mainly based on the photosynthetic pigments. In addition to this cell wall composition and stores food are also the base of classification.

Algae is divided into following divisions		
(1) CHLOROPHYTA	**-**	**GREEN ALGAE**
(2) PHAEOPHYTA	**-**	**BROWN ALGAE**
(3) XANTHOPHYTA	**-**	**YELLOW - GREEN ALGAE**
(4) RHODOPHYTA	**-**	**RED ALGAE**

CHOLOROPHYTA

Green Algae

- Green algae is the **most advanced** algae. It is believed that green algae are the ancestor of the higher plants.
- **Habitat :** Green algae is comopolitan in nature.

Different forms of Green algae (Structure) :

Green algae is found in many forms

(1) Unicellular :-

(i) ***Chlamydomonas :*** Motile unicellular algae. This algae moves with the help of flagella.

(ii) ***Chlorella -*** Non motile unicellular algae.
- Calving discovered "Calvin cycle" by experimenting or *Chlorlela.*

(iii) ***Acetabularia -*** Umbrella plant - It is the largest unicellular plant. The diameter of its cell is 10 cm.
- Hammerling experimented on *Acetabularia.*

(2) Coenocytic - Some green algae are coenocytic i.e. multinucleated.
e.g. *Caulerpa*
Note :- According to five kingdom system the algae described above should be placed in Protista but exceptionally its life cycle is similar to green algae. Therefore it is placed in Plantae.

(3) Colonial - Some green algae are found in colonies. They form colony of cell. The number of cells in a colony is fixed. Colony with fixed number of cells called coenobium.

eg. *Volvox* - Motile colony
Hydrodictyon - Non motile colony (called as water net)

(4) Multicellular filamentous - Mostly algae are multicellular filamentous.
e.g. *Ulothrix* - Known as pond wool
Spirogyra - Known as pond sill

Note : Some green algae are heterotrichous i.e. two types of branches prostrate and erect – **Fritscheilla, Stigeoclonium Coleochaeta** (Fritscheilla tuberosa has approach to the early land plants)

(5) Multicellular thalloid or Parenchymatous - Some algae are multicellular in length & width.
eg. *Ulva* - Also called as sea lettuce

Photosynthetic pigments :

Chlorophyll	-	Chl 'a' and Chl 'b'
Carotene	-	β carotene
Xanthophyll	-	Luteaxanthin and Violoxanthin - Hellow coloured.

Note: The green colour of green algae is due to chlorophyll.

Stored food : In green algae the food is stored in the form of **starch**

Note : On the basis of pigments (Chl 'a', Chl 'b', Carotenoids) stored food (starch) & cell wall (made up of cellulose or pectin), green algae is considered similar to higher plants.

Economic Importance. :

(1) Food -
Chlorella is used as food, because after *Spirulina, Chlorella* has largest amount of protein.

(2) Antibiotics -
Chlorellin antibiotic is obtained from *Chlorella.*

(3) Space research -
In space, *Chlorella* is used as a source of food and O_2.

(4) Parasitic algae -
Cephaleuros algae remains parasitically in the leaves of tea plant and cause disease **'red rust'.**

PHAEOPHYTA

Brown algae or kelps or Sea weeds.

- Brown algae are found in marine water.
- Brown algae are multicellular filamentous.
- Brown algae are the largest in size (up to 60 meter in length).
- Largest brown algae - ***Macrocystis***
- Thallus of brown algae is divided into two parts :
  (i) **Lamina** - Leafy part of photosynthetic part
  (ii) **Stipe** - Elongated tubes called **trumpet hyphae** are present for food conduction in stipe. Trumpet hyphae are analogus to sieve tubes of vascular plants.
  Due to lamina and stipe brown algae look like leaf (leaf algae).

Pigments :

Chlorophyll	-	Chl 'a' , Chl 'c'
Carotene	-	Only β carotene
Xanthophylls	-	Mainly Fucoxanthin

Note : The amount of Fucoxanthin is more in brown algae due to which this algae is brown in colour (Xanthophylls are mostly yellow but fucoxanthin is brown)

Stored food :

Laminarin and mannitol - both are derivatices of carbhohyddrates.

Phycocolloids :

- In the cells wall of brown algae some colloid substances like **fucinic acid, alginic** acid and **fucoidin** are present which are known as phycocolloids.
- Phycocoloids protects brown-algae against desiccation and shocks. Phycocoloids are used in ice-cream to make them more viscous. Alginates, salts of alginic acid used for dentury measurement.

Special name :

(1) ***Postelsia :***

It is known s Sea palm.

(2) ***Ancyclonema -***

Is is called Ice bloom because it grows on marine ice.

(3) ***Sargassum -***

It is known as Gulf weed because *Sargssum* is a free floating algae. It grows rapidly in North Atlantic ocean and covers thousands of hectares of area. Therefore this region is called as sargasso sea.

(4) ***Laminaria (Kelps)-***

It is called as Devil's Aprin.

Economic Importance :

(1) Alginates or Alginic acid - Obtained from *Laminaria, Fucus, Macrocystis.*

Alginates is used in the manufacturing of soap, ice-cream, polish, cream and plastic.

(2) Iodine and Bromine - Obtained from *Laminaria.*

XANTHOPHYTA

Yellow Green Algae

Habitat and Structure :

All the algae in this group of **acellular coenocytic** and are found in moist soil.

Pigments :

Chlorophyll	-	Chl 'a' , Chl 'e'
Carotene	-	β carotene
Xanthophylls	-	Many

Note : The yellow colour of these algae is due to the presence of xanthophyll.

Stored food :

Leucosin and Oil (Leucosin is derivative of carbohydrate)

eg. *Vaucheria, Botrydium, Tribonema.*

Note : In *Vacucheria* algae some special type of spores are formed which are known as synzoospores.

RHODOPHYTA

Red Algae

(1) Red algae is second most **ancient algae** after blue green algae i.e. they are developed after blue green algae.

eg. ***Polysiphonia***

(2) Red algae mainly found in **marine** water. But exceptionally ***Batrachospermum*** is found in fresh water (river) and ***Poryphyridium*** is found on land.

(3) Red algae are **multicellular** but exceptionally ***Prophyridium*** is unicellular.
(4) There is **no motile stage** found in life cycle of red algae and BGA i.e. cilia & flagella are absent.
(5) Cell wall of red algae is complex and made up of cellulose & pectin.
The cell was of red algae is also complicated like blue green algae. Their cell wall has many different type of substances such as ***xylan, galactose, polyurinoc acid, polysulphate esters.***
But in some algae calcium carbonate is also present in the cell wall. Due to which their thallus become stony. These algae form lime stone & coral reefs
e.g. ***Corallina*** and ***Lithothamnion.***

Pigments :

Chlorophyll - Chl 'a' and Chl 'd'
Carotense - β
Phycobilins - R - phycoerythrin (red coloured) and R - phycocyanin (blue coloured)

(1) On the basis of pigments red algae is similar to blue green algae.
(2) Colour of red algae changes according to depth in sea this is called as ***Gaudikov's effect.***
(3) When red algae are present on the surface of the sea then their colour is **blue** and when they are at the bottom, their colour is **red.** At the surface of sea the amount of **R - phycocyanin** is more while in depth the amount of **R - phycoerythrin** is more.
Penetration power is maximum in ultra violet and violet light. R-phycoerythrin is only pigment to absorb ultra violet and violet light. Due to **phycoerythrin** red algae are **deepest** algae.
(4) **Gaudikov's** effect is also found in Blue - Green algae.
(5) Red algae not always red, it may be clue coloured also.
eg. Batrchospermum - This is blue coloured algae.

Stored Food :

Floridean starch - It is a primitive type of starch. Structurally floridean starch is similar to the cyanophycean starch of blue green algae. Starch of higher plants is less branched yet floridean starch in highly branched.

Glycogen is also highly branched so that floridean & cynanophycean starch is **structurally** similar to **glycogen.**

Phycocolloid :

Agar, carrageen and funori phycocolloids are found in the cell was of red algae.

Reproduction :

(1) Vegetative - By fragmentation
(2) Asexual - Non motile spores [By monospore, carpospores, tetraspore]
(3) Sexual reproduction –

(i) Sexual reproduction is *oogamous* type.

(ii) The female sex organs are called **carpogonia.** They are apparently similar to archegonia of bryophyta. Carpogonia is unicellular & jacketless but archegonia is multicellular & jacketed.

(iii) The male sex organs of red algae are known as **spermatangia.** Non motile spores like gametes are formed in spermatangia which are known as spermatia.

(iv) Exceptionally life cycle of ***Polysiphonia*** is diplontic

Special points and Economic importance.

(1) ***Harveyella -*** It is a colourless parasitic algae. It remains as **parasite** on other algae.
(2) Porphyra – It is an edible algae.

(3) ***Gelidium and Gracilaria*** **- Agar - Agar** colloid is obtained from these. It is used to prepare culture medium
(4) ***Chondrus crispus*** **-** It is also called Irish moss. **Carrageenin** colloid is obtained from this algae. It is used as gelating agent in food industries (i.e. to make the food item viscous)
- Capsule of medicines is also prepared from carrageenin.

(5) ***Haematococcus nivalis*** **-** "Red snow" - It likes to grow on snow and impart red colour to snow.

HABITAT OF SOME IMPORTANT ALGAE

(1) ***Terrestrial*** **-** The algae found in moist soil & wall.
eg. *Terrentofolia*
(2) ***Epiphytes*** **-** Algae which are present on plants
eg. *Protococcus*
(3) ***Endophytes*** **-** Algae which are present inside plants
eg. *Coleochaete nitelum* (in Nitella plant)
(4) ***Epizoic*** **-** Algae which are present on animals
eg. *Cladophora* (present on Mollusca shell)
(5) ***Endozoic*** **-** Algae which are present inside the body of animals
eg. *Zoochlorella and Zooxenthellae* (inside the Hydra)
(6) ***Parasites*** **-** Algae that live as parasite and causes diseases
eg. *Cephaleuros* (algae remains in the leaves of tea plant)
Cephaleuros causes red rust disease of tea
(7) ***Thermophili*** **-** Algae found in hot water.
eg. *Chlorella*
(8) ***Cryophytes*** **-** Algae which are present in polar regions & Low Temperature.
eg. *Chlamydomonas (some species)*
Haematococcus nivalis (It develops red snow in polar region)
(9) ***Epiphloephytes*** **-** Algae arise on bark of trees.

THALLOPHYTA

(1) The term "Thallophyta" was given by **"Endlcher"** According to two kingdom classification, all the **algae, fungi** and **bacteria** are placed in thallophyta, because their plant body is similar to thallus.

(2) All the tahllophytes are non vascular.

(3) In thallophyta plant is haploid i.e. **gametophyte**
Eg. Green algae, Red algae, yellow green algae, Dinoflagellate, Cellular slime mold.
Note : Exceptionally in some thallophytes, plant is diploid i.e. **sporophytes**
Eg. Brow algae, Diatoms, Acellular slime molds.

(4) In thallophyta the male sex organs are called as **Antheridia** and female sex organs are called as **Oogonia.** Sex organs are unicellular & Jacket less [Jacket - layer of sterile cells]

(5) The sexual reproduction in thallphyta is **isogamous, anisogamous** and **oogamous.**
(6) In thallophyta, sex, reproduction takes place through **zygotic meiosis,** therefore embryo is not formed.

Demerits of Two kingdom classification :

(1) In two kingdom classification Prokaryotes and Eukaryotes placed in the same group.
(2) In this system photosynthetic green algae and non photosynthetic fungi are placed in same group i.e. plantae.
(3) Two kingdom system takes unicellular and multicellular organism together.
(4) On the basis of cell was bacteria were considered as plant and put in plantae.
(5) Position of Euglena was not fixed.