

CC 1 : PHYCOLOGY

UNIT – 4

Algae
(Part 6)

Classification of Algae by Robert Edward Lee (1989) :

Robert Edward Lee classified the algae into four evolutionary groups, 15 divisions and classes based on the evolutionary features. (“Phycology” by R. E. Lee, 1989, 2nd Edn.)

The basis of classification includes :

- a. Presence or absence of proper chloroplast,
- b. Nature of ribosomes,
- c. Content of primary photosynthetic pigment,
- d. Presence or absence of phycobilliproteins,
- e. Number of the membrane of chloroplast and its nature,
- f. Type of reserve food material,
- g. Number of flagella and their position.

The classification is as follows –

Group 1. Prokaryotic algae.

The prokaryotic algae have outer plasma membrane enclosing protoplasm –

- (i) Containing photosynthetic thylakoids,
- (ii) 70s ribosomes,
- (iii) DNA fibrils not enclosed within a separated membrane,
- (iv) Chlorophyll a is the main photosynthetic pigment.

They are further classified into –

- I. Division. **Cyanophyta** : Chlorophyll a; phycobiliproteins.
- II. Division. **Prochlorophyta** : Chlorophyll a and b; no phycobiliproteins.

Group 2. Eukaryotic algae with chloroplast surrounded only by the two membranes of the chloroplast envelope.

They are further classified into –

- I. Division. **Glaucophyta** : algae that represent an intermediate position in the evolution of chloroplast; photosynthesis is carried out by modified endosymbiotic blue-green algae.
- II. Division. **Rhodophyta** : Chlorophyll a and b; phycobilliproteins; no flagellated cells; storage product is Floridean starch.
- III. Division. **Chlorophyta** : Chlorophyll a and b; storage product is starch.

Group 3. Eukaryotic algae with chloroplast surrounded by one membrane of chloroplast endoplasmic reticulum.

They are further classified into –

- I. Division. **Euglenophyta** : Chlorophyll a and b; one flagellum with a spiraled row of fibrillar hairs; proteinaceous pellicle in strips under the plasma membrane; storage product is paramylon; characteristic type of cell division.
- II. Division. **Dinophyta** : Chlorophyll a and c_1 ; cell commonly divides into an epicone and a hypocone by a girdle; helical transverse flagellum.

Group 4. Eukaryotic algae with chloroplast surrounded by two membranes of chloroplast endoplasmic reticulum.

They are further classified into –

- I. Division. **Cryptophyta** : Chlorophyll a and c; phycobilliproteins.
- II. Division. **Crysophyta** : Chlorophyll a and c_1 and sometimes c_2 ; fucoxanthin; anterior tinsel and posterior whiplash flagella; storage product chrysolaminarin is found in vesicles of cytoplasm.
- III. Division. **Prymnesiophyta** : Chlorophyll a, c_1 and c_2 ; fucoxanthin; two whiplash flagella; storage product chrysolaminarin is found in vesicles of cytoplasm.

- IV. Division. **Bacillariophyta** : Chlorophyll a, c₁ and c₂; fucoxanthin; one posterior tinsel flagellum on sperm; storage product chrysolaminarin is found in vesicles of cytoplasm.
- V. Division. **Xanthophyta** : Eye-spot in chloroplast; Chlorophyll a and c; anterior tinsel and posterior whiplash flagellum.
- VI. Division. **Eustigmatophyta** : Eye-spot outside chloroplast; Chlorophyll a; anterior tinsel and posterior whiplash flagellum (commonly reduced).
- VII. Division. **Raphidophyta** : Chlorophyll a and c; anterior tinsel and posterior whiplash flagellum.
- VIII. Division. **Phaeophyta** : Chlorophyll a, c₁ and c₂; fucoxanthin; anterior tinsel and posterior whiplash flagellum; storage product chrysolaminarin is found in vesicles of cytoplasm.

Table : First appearance of algae in the geological time scale

Era	Period	Epoch	Million years ago	First appearance of algal fossil
Cenozoic	Quaternary	Holocene		
		Pleistocene	1.8	
	Tertiary	Pliocene	5.5	
		Miocene	25.0	Xanthophyta
		Oligocene	36.0	
		Eocene	53.5	Euglenophyta
		Palaeocene	65.0	
Mesozoic	Cretaceous		135	Chrysophyta
	Jurassic		205	
	Triassic		245	Bacillariophyta
Paleozoic	Permian		290	Prymnesiophyta
	Carboniferous		380	
	Devonian		430	
	Silurian		460	Stonewarts (Chlorophyta)
	Ordovician		530	
	Cambrian		610	
Precambrian	Proterozoic		3000	Cyanophyta Rhodophyta Chlorophyta

Characteristics	Cyanophyceae	Rhodophyceae	Chlorophyceae	Bacillariophyceae	Xanthophyceae	Pheophyceae
Cell structure	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	Mainly mucopeptide and muramic acid	Inner layer cellulosic and outer pectic.	Mainly cellulosic and pectic material.	Mainly silica and pectic material.	Cellulosic.	Inner layer cellulosic and outer layer consists of alginic and fusic acid.
Flagella	Non-flagellate.	Non-flagellate.	Motile cells have 2, 4 or more flagella, whiplash type and anteriorly inserted.	Motile cells have 1 or sometimes 2 tinsel type and anteriorly inserted.	Motile forms have 2 flagella, unequal, 1 tinsel and 1 whiplash.	Motile forms have 2 flagella, unequal, 1 tinsel and 1 whiplash, laterally inserted.
Green pigments	Chlorophyll a.	Chlorophyll a and d.	Chlorophyll a and b.	Chlorophyll a and c.	Chlorophyll a and e.	Chlorophyll a and c.
Other pigments	c-phycoyanin (blue), c-phycoerythrin (red), β -carotene, myxoxanthin, myxoxanthophyll.	r-phycoyanin, r-phycoerythrin, α and β -carotene, xanthophylls (lutein, tetraaxanthin etc.).	α and β -carotene, and xanthophylls.	β -carotene, xanthophylls (fucoxanthin).	β -carotene and xanthophylls.	β -carotene, xanthophylls (fucoxanthin).
Nature of nucleus	Nuclear membrane and nucleolus absent. DNA is not associated with histones, thereby chromosomes are not formed.	Nucleus well organized and chromosome formed during cell division.	Nucleus well organized and chromosome formed during cell division.	Nucleus well organized and chromosome formed during cell division.	Nucleus well organized and chromosome formed during cell division.	Nucleus well organized and chromosome formed during cell division.
Stored food	Cyanophycean starch and cyanophycean protein.	Floridean starch.	Starch and fat.	Oil, volutin, chrysolaminarin.	Oil, lipid and lucosin.	Laminarin, mannitol and sucrose.