

Chlorophyta



Green algae on coastal rocks at Shihtiping in Taiwan

Chlorophyta is a division of green algae, informally called **chlorophytes**. The name is used in two very different senses, so care is needed to determine the use by a particular author. In older classification systems, it refers to a highly paraphyletic group of *all* the green algae within the green plants (Viridiplantae) and thus includes about 7,000 species^{[6][7]} of mostly aquatic photosynthetic eukaryotic organisms. In newer classifications, it refers to one of the two clades making up the Viridiplantae, which are the chlorophytes and the streptophytes. The clade Streptophyta consists of two divisions, the Charophyta and the Embryophyta.^{[8][9]} In this sense the Chlorophyta includes only about 4,300 species.^[4] Like the land plants (bryophytes and tracheophytes), green algae contain chlorophyll a and chlorophyll b and store food as starch^[6] in their plastids.

The division contains both unicellular and multicellular species. While most species live in freshwater habitats and a large number in marine habitats, other species are adapted to a wide range of environments. Watermelon snow, or *Chlamydomonas nivalis*, of the class Chlorophyceae, lives on summer alpine snowfields. Others live attached to rocks or woody parts of trees. *Monostroma kuroshiensis*, an edible green alga cultivated worldwide and most expensive among green algae, belongs to this group. Some lichens are symbiotic relationships between fungi and green algae.

Members of the Chlorophyta also form symbiotic relationships with protozoa, sponges, and cnidarians. All are flagellated,^[10] and these have an advantage of motility. Some conduct sexual reproduction, which is oogamous or isogamous.

1 Ecology

Species of Chlorophyta (treated as what is now considered one of the two main clades of Viridiplantae) are common inhabitants of marine, freshwater and terrestrial environments.^{[11][12]} Several species have adapted to specialised and extreme environments, such as deserts, arctic environments, hypersaline habitats, marine deep waters and deep-sea hydrothermal vents.^{[13][14][15]} Some groups, such as the Trentepohliales are exclusively found on land.^[16] Several species of Chlorophyta live in symbiosis with a diverse range of eukaryotes, including fungi (to form lichens), ciliates, forams, cnidarians and molluscs.^[12] Some species of Chlorophyta are heterotrophic, either free-living or parasitic.^{[17][18]} Two common species of the heterotrophic green alga *Prototheca* are pathogenic and can cause the disease protothecosis in humans and animals.^[19]

2 Classifications

Further information: [Wikispecies:Chlorophyta](#)

Characteristics like type of zoid, mitosis (karyokinesis), cytokinesis, organization level, life cycle, type of gametes, cell wall polysaccharides^[20] and more recently genetic data are used for the classification of Chlorophyta.

2.1 Leliaert *et al.* 2012

Simplified phylogeny of the Chlorophyta, according to Leliaert *et al.* 2012.^[12] Note that many algae previously classified in Chlorophyta are placed here in Streptophyta.

- Viridiplantae
 - Chlorophyta
 - core chlorophytes
 - Ulvophyceae
 - Cladophorales
 - Dasycladales
 - Bryosidales
 - Trentepohliales
 - Ulvales-Ulotrichales
 - Oltmannsiellopsidales
 - Chlorophyceae

- Oedogoniales
- Chaetophorales
- Chaetopeltidiales
- Chlamydomonadales
- Sphaeropleales
- Trebouxioephyceae
- Chlorellales
- Oocystaceae
- Microthamniales
- Trebouxiales
- *Prasiola* clade
- Chlorodendrophyceae
- prasinophytes (paraphyletic)
 - Pyramimonadales
 - Mamiellophyceae
 - Pycnococcaceae
 - Nephroselmidiophyceae
 - Prasinococcales
 - Palmophyllales
- Streptophyta
 - charophytes
 - Mesostigmatophyceae
 - Chlorokybophyceae
 - Klebsormidiophyceae
 - Charophyceae
 - Zygnematophyceae
 - Coleochaetophyceae
 - Embryophyta (land plants)
- Order Sphaeropleales (sensu Deason, plus *Bracteacoccus*, *Schroederia*, *Scenedesmaceae*, *Selanastraceae*)
- Order Oedogoniales
- Order Chaetopeltidiales
- Order Chaetophorales
- Incertae Sedis (*Cylindrocapsa* clade, *Mychonastes* clade)
- Class Ulvophyceae (ulvophytes)
 - Order Ulotrichales
 - Order Ulvales
 - Order Siphonocladales/Cladophorales
 - Order Caulerpaceae
 - Order Dasycladales
- Class Trebouxioephyceae (trebouxio-phytes)
 - Order Trebouxiales
 - Order Microthamniales
 - Order Prasiolales
 - Order Chlorellales
- Class Prasinophyceae (prasinophytes)
 - Order Pyramimonadales
 - Order Mamiellales
 - Order Pseudoscourfieldiales
 - Order Chlorodendrales
 - Incertae sedis (Unnamed clade of coccoid taxa)
- Division Charophyta (charophyte algae and embryophytes)
 - Class Mesostigmatophyceae (mesostigmatophytes)
 - Class Chlorokybophyceae (chlorokybophytes)
 - Class Klebsormidiophyceae (klebsormidiophytes)
 - Class Zygnemophyceae (conjugates)
 - Order Zygnematales (filamentous conjugates and saccoderm desmids)
 - Order Desmidiales (placoderm desmids)
 - Class Coleochaetophyceae (coleochaetophytes)
 - Order Coleochaetales
- Subdivision Streptophytina
 - Class Charophyceae (reverts to use of GM Smith)
 - Order Charales (charophytes sensu stricto)
 - Class Embryophyceae (embryophytes)

2.2 Pombert *et al.* 2005

A possible classification when Chlorophyta refers to one of the two clades of the Viridiplantae is shown below.^[21]

- Class Prasinophyceae T. A. Chr. ex Ø. Moestrup & J. Thronsen
- Class Chlorophyceae Wille
- Class Trebouxioephyceae T. Friedl
- Class Ulvophyceae K. R. Mattox & K. D. Stewart

2.3 Lewis & McCourt 2004

- Division Chlorophyta (green algae sensu stricto)
 - Subdivision Chlorophytina
 - Class Chlorophyceae (chlorophytes)
 - Order Chlamydomonadales (+ some Chlorococcales + some Tetrasporales + some Chlorosarcinales)

2.4 Hoek, Mann and Jahns 1995

Classification of the Chlorophyta, treated as all green algae, according to Hoek, Mann and Jahns 1995.^[6]

- Class Prasinophyceae (orders Mamiellales, Pseudocourfeldiales, Pyramimonadales, Chlorodendrales)
- Class Chlorophyceae (orders Volvocales [including the Tetrasporales], Chlorococcales, Chaetophorales, Oedogoniales)
- Class Ulvophyceae (orders Codiolales, Ulvales)
- Class Cladophorophyceae (order Cladophorales)
- Class Bryopsidophyceae (orders Bryopsidales, Halimedales)
- Class Dasycladophyceae (order Dasycladales)
- Class Trentepohliophyceae (order Trentepohliales)
- Class Pleurastrophyceae (order Pleurastrales)
- *Incertae sedis* (order Prasiolales)
- Class Klebsormidiophyceae (orders Klebsormidiales, Coleochaetales)
- Class Zygnematophyceae (order Zygnematales, Desmidiiales)
- Class Charophyceae (order Charales)

In a note added in proof, an alternative classification is presented for the algae of the class Chlorophyceae:

- Class Chlamydoephyceae (orders Volvocales, Chlorococcales, Chaetophorales)
- Class Oedogoniophyceae (order Oedogoniales)
- Class Chlorophyceae (order Chlorellales)

2.5 Bold and Wynne 1985

Classification of the Chlorophyta and Charophyta according to Bold and Wynne 1985.^[22]

- Chlorophyta, Chlorophyceae (16 orders)
 - Volvocales
 - Tetrasporales
 - Chlorococcales
 - Chlorosarcinales
 - Ulotrichales
 - Sphaeropleales
 - Chaetophorales

- Trentepohliales
- Oedogoniales
- Ulvales
- Cladophorales
- Acrosiphoniales
- Caulerpales
- Siphonocladales
- Dasycladales
- Zygnematales
- Charophyta, Charophyceae (1 order)
 - Charales

2.6 Mattox & Stewart 1984

Classification of the Chlorophyta according to Mattox & Stewart 1984.^[23]

- Micromonadophyceae Mattox & Stewart (similar to Prasinophyceae; Tetraselmidiales transferred to Pleurastrophyceae)
- Charophyceae Rabenhorst
 - Chlorokybales
 - Klebsormidiales
 - Zygnematales
 - Coleochaetales
 - Charales
- Ulvophyceae Mattox & Stewart
- Pleurastrophyceae Mattox & Stewart
 - Tetraselmidiales
 - Pleurastrales
- Chlorophyceae Wille in Warming
 - Chlamydomonadales
 - Volvocales
 - Chlorococcales
 - Sphaeropleales
 - Chlorosarcinales
 - Chaetophorales
 - Oedogoniales

2.7 Fott 1971

Classification of the Chlorophyta according to Fott 1971.^[24]

- Class Chlorophyceae
 - Order Volvocales
 - Order Tetrasporales
 - Order Chlorococcales
 - Order Ulotrichales
 - Suborder Chlorosarcineae
 - Suborder Ulotrichineae
 - Suborder Oedogoniineae
 - Suborder Chaetophorineae
 - Order Siphonocladales
 - Order Bryopsidales
- Class Conjugatophyceae
- Class Charophyceae

2.8 Round 1971

Classification of the Chlorophyta and related algae according to Round 1971.^[25]

- "green algae"
 - Euglenophyta
 - Prasinophyta
 - Charophyta
 - Chlorophyta
 - Zygnemaphyceae (= Conjugatophyceae; orders Mesotaeniales, Zygnematales, Gonatozygales, Desmidiales)
 - Oedogoniophyceae (order Oedogoniales)
 - Bryopsidophyceae
 - Hemisiphoniidae (orders Cladophorales, Sphaeropleales, Acrosiphoniales)
 - Cystosiphoniidae (orders Dasycladales, Siphonocladales, Chlorochytriales)
 - Eusiphoniidae (orders Derbesiales, Codiales, Caulerpales, Dichotomosiphonales, Phyllosiphonales)
 - Chlorophyceae
 - orders Chlamydomonadales, Volvocales, Polyblepharidales, Tetrasporales, Chlorodendrales, Chlorosarcinales, Chlorococcales

- orders Ulotrichales, Codiolales, Ulvales, Prasiolales, Cyliandrocapsales, Microsporales
- orders Chaetophorales, Coleochaetales, Trentepohliales, Pleurococcales, Ulvellales

2.9 Smith 1938

Classification of the Chlorophyta according to Smith 1938:

- Class 1. Chlorophyceae
 - Order 1. Volvocales
 - Family 1. Chlamydomonadaceae
 - Family 2. Volvocaceae
 - Order 2. Tetrasporales
 - Order 3. Ulotrichales
 - Family 1. Ulotrichaceae
 - Family 2. Microsporaceae
 - Family 3. Cyliandrocapsaceae
 - Family 4. Chaetophoraceae
 - Family 5. Protococcaceae
 - Family 6. Coleochaetaceae
 - Family 7. Trentepohliaceae
 - Order 4. Ulvales
 - Family 1. Ulvaceae
 - Family 2. Schizomeridaceae
 - Order 5. Schizogoniales
 - Family Schizogoniaceae
 - Order 6. Cladophorales
 - Family 1. Cladophoraceae
 - Family 2. Sphaeropleaceae
 - Order 7. Oedogoniales
 - Family Oedogoniaceae

- Order 8. Zygnematales
 - Family 1. Zygnemataceae
 - Family 2. Mesotaeniaceae
 - Family 3. Desmidiaceae
- Order 9. Chlorococcales
 - Family 1. Chlorococcaceae
 - Family 2. Endosphaeraceae
 - Family 3. Characiaceae
 - Family 4. Protosiphonaceae
 - Family 5. Hydrodictyaceae
 - Family 6. Oöcystaceae
 - Family 7. Scenedesmeaceae
- Order 10. Siphonales
 - Family 1. Bryopsidaceae
 - Family 2. Caulerpacaeae
 - Family 3. Halicystaceae
 - Family 4. Codiaceae
 - Family 5. Derbesiaceae
 - Family 6. Vaucheriaceae
 - Family 7. Phyllosiphonaceae
- Order 11. Siphonocladiales
 - Family 1. Valoniaceae
 - Family 2. Dasycladaceae
- Class 2. Charophyceae
 - Order Charales
 - Family Characeae

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4 Further reading

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