

**\*\*Look for your assignment on page 2...**

- Research and record defining characteristics of your group of green algae (15-30 min)
- Not every group will have the same amount of relevant details.

**Green Algae**

The Green algae are a paraphyletic group of approximately 17,000 species (land plants nested within)

**Ancestral characters of Green algae and land plants:** Chlorophyll *a* and *b*, storage of starch in plastids

**Some green algae have characteristics also found in (or ancestral to) land plants:**

cell walls containing cellulose, hemicellulose, and pectin; asymmetrical flagellated sperm with **multilayered structure**; breakdown of nuclear envelope, persistent spindle, and phragmoplast in mitosis

**Groups and Key characteristics**

*Grey text and boxes are non-essential points.*

	<b>Chlorophyceae</b>	<b>Ulvophyceae</b>	<b>Charophyceae</b>
<b>Key characteristics</b>	Largest class of Green Algae, Mainly freshwater, Sexual reproduction is via <b>zygotic meiosis</b>	Primarily marine, Only green algae with alternation of generations and <b>sporic meiosis</b>	<b>Sister to land plants, Zygotic meiosis</b>
<b>Details of Mitosis</b>			
Does nuclear envelope dissolve?	Closed mitosis, persistent nuclear envelope	Closed mitosis, persistent nuclear envelope	Open mitosis, nuclear envelope dissolves
Mitotic spindle	Not persistent	persistent	persistent
Specifics of cytokinesis:	Phycoplast		<b>Phragmoplast*</b> Cell plate <b>Plasmodesmata*</b>
<b>Structures of flagella</b>			
<i>Which has some similarity to bryophytes?</i>	<b>Flagellar roots</b>	na	<b>Flagellar roots</b> <b>Multilayered structure</b>

\*Define **Phragmoplast**: a scaffold found in some algal cells which aids in forming the cell plate and plasmodesmata. ([image ppt link](#))

\*Define **Plasmodesmata**: strands of cytoplasm between cell walls that allows for substance transportation between said cells.

**Life Cycles:**

**Define zygotic meiosis:** Zygotic meiosis is a type of meiosis occurring in the zygote, during the process the zygote undergoes meiosis, reducing its chromosome number by half. This leads to the formation of haploid cells. ([zygotic meiosis - Search Images](#))

**Define sporic meiosis:** diploid organism (sporophyte) undergoes meiosis to produce haploid spores and develop into a haploid organism (gametophyte) that produce gametes which lead to fertilization and the formation of a new diploid zygote. It's an alternation of generations of a diploid sporophyte and a haploid gametophyte with meiosis occurring to produce spores. [sporic meiosis life cycle diagram](#)

<b>Chlorophyceae</b>			
<b>Group</b>	<b>Body form</b> (e.g. motile or not? Unicellular or multicellular? Colonial?)	<b>Life Cycle notes</b> (e.g. sexual? asexual? interesting location notes or propagules?)	<b>Other details</b> (e.g., ecological or taxonomic notes)
<i>Chlamydomonas</i>	<ul style="list-style-type: none"> <li>● Motile (they have flagella that help “pull” them along.</li> <li>● Unicellular</li> <li>● Described as oval in shape</li> </ul>	<ul style="list-style-type: none"> <li>● Sexual and asexual reproduction</li> <li>● Found all over the world in soil, fresh water, oceans, and even in snow on mountaintops</li> </ul>	<ul style="list-style-type: none"> <li>● They have an “eyespot” near the flagella that help them to sense light</li> <li>● forced photoautotrophs or optional heterotrophs</li> <li>● Belong to the family Chlamydomonadaceae</li> </ul>
<i>Volvox</i>	<ul style="list-style-type: none"> <li>● motile (joint action aka. flagella)</li> <li>● multicellular + colonial</li> <li>● hollow + spherical</li> </ul>	<ul style="list-style-type: none"> <li>● both sexual + asexual</li> <li>● reproduction depends on environmental conditions</li> <li>● found in puddles to any body of water (fresh)</li> </ul>	<ul style="list-style-type: none"> <li>● primary producer</li> <li>● food for small invertebrates</li> <li>● class = Chlorophyceae</li> <li>● order = Volvocaceae</li> <li>● first recorded in 1700</li> <li>● also known as globe algae</li> </ul>
<i>Chlorococcum</i>	<ul style="list-style-type: none"> <li>● non-motile</li> <li>● unicellular</li> <li>● spherical or ellipsoidal</li> </ul>	<ul style="list-style-type: none"> <li>● sexual and asexual</li> <li>● freshwater and marine habitats</li> </ul>	<ul style="list-style-type: none"> <li>● the chloroplast is cup-shaped, parietal, and has one pyrenoid</li> <li>● visibly darker green than other Chlorophytes</li> <li>● They often look like an ink blot and organelles are difficult to see</li> <li>● known for its lipid and starch content</li> </ul>
<i>Hydrodictyon</i>	<ul style="list-style-type: none"> <li>● Nonmotile</li> <li>● colony of large cylindrical cells</li> </ul>	<ul style="list-style-type: none"> <li>● Asexual division inside parent cell</li> </ul>	<ul style="list-style-type: none"> <li>● common in algal blooms</li> <li>● isogamous asexual reproduction</li> </ul>
<i>Oedogonium</i>	<ul style="list-style-type: none"> <li>● -Non-motile</li> <li>● -Multicellular</li> <li>● - Forms filamentous colonies</li> <li>● - Cylindrical cells</li> </ul>	<ul style="list-style-type: none"> <li>● - Has haploid and diploid phases</li> <li>● Both asexual and sexual</li> <li>● Haploid gametophyte, fertilization, diploid sporophyte, zoospore germination</li> </ul>	<ul style="list-style-type: none"> <li>● -Kingdom: Plantae, Phylum: Chlorophyta, Class: Chlorophycaceae, Order: Oedogoniales, Genus: Oedogonium</li> <li>- Found in freshwater</li> </ul>

			-Grows attached to underwater surfaces or free floats. -Pyrenoids
<i>Fristchella</i>	<ul style="list-style-type: none"> <li>● non-motile</li> <li>● multicellular</li> <li>● filamentous</li> <li>● thalloid body structure</li> <li>● horizontal growth w/ with erect filaments</li> <li>● non-colonial</li> </ul>	<ul style="list-style-type: none"> <li>● both sexual and asexual</li> <li>● isogamous or anisogamous</li> <li>● zoospores</li> <li>● gamete are motile</li> <li>● found in moist soils</li> <li>● spends most of its life in the haploid phase</li> <li>● only diploid as zygote</li> </ul>	<ul style="list-style-type: none"> <li>● Kingdom: Plantae (or Viridiplantae, depending on classification systems)</li> <li>● Phylum: Chlorophyta</li> <li>● Class: Chlorophyceae</li> <li>● Order: Chaetophorales</li> <li>● Genus: Fritschella</li> </ul> <p>soil stabilization and nutrient cycling</p>

Chlorophyceae			
Group	Body form (e.g. motile or not? Unicellular or multicellular? Colonial?)	Life Cycle notes (e.g. sexual? asexual? interesting location notes or propagules?)	Other details (e.g., ecological or taxonomic notes)
<i>Cladophora</i>	<ul style="list-style-type: none"> <li>● motile</li> <li>● multicellular</li> <li>● forms colonies on rocks, wood, and logs, but can also float on the surface of water</li> </ul>	<ul style="list-style-type: none"> <li>● reproduces primarily through asexual reproduction                             <ul style="list-style-type: none"> <li>○ releases zoospores</li> </ul> </li> <li>● can sometimes reproduce sexually                             <ul style="list-style-type: none"> <li>○ male and female gametes fuse together to form a zygote</li> </ul> </li> <li>● isomorphic life cycle - the sporophyte and gametophyte look identical</li> </ul>	<ul style="list-style-type: none"> <li>● important in freshwater and saltwater ecosystems</li> <li>● protects bacteria from predators and radiation</li> <li>● negatively impacts growth of submerged plants</li> <li>● rough texture with thick walls</li> <li>● bright green</li> </ul>
<i>Ulva</i>	<ul style="list-style-type: none"> <li>● Ulva are not motile as an adult but produce motile reproductive cells.</li> <li>● Multicellular</li> <li>● Ulva is not a colonial organism</li> </ul>	<ul style="list-style-type: none"> <li>● Asexual and sexual. Ulva alternates between its phases in its life cycle.</li> <li>● Asexually through production of zoosporoids.</li> <li>● Sexuality involves gametes.</li> <li>● Can be found in rocky shores</li> </ul>	<ul style="list-style-type: none"> <li>● Is considered a primary producer in marine ecosystems.</li> <li>● converts sunlight into organic matter providing food.</li> <li>● Is in the subphylum: chlorophytina, class: Ulvophyceae, order: Ulvales, family: Ulvaceae</li> </ul>

Plant Biology – Green Algae Groups

<p><i>Codium</i></p>	<ul style="list-style-type: none"><li>● composed of a single, giant, branched tubular cell containing multiple nuclei</li><li>● not motile</li><li>● colonial and multicellular</li></ul>	<ul style="list-style-type: none"><li>● temperate and subtropical areas, but can live in any habitat i.e. wavy coasts or calm lagoons</li><li>● asexually produces through fragmentation making it spread very effectively</li></ul>	<ul style="list-style-type: none"><li>● edible</li><li>● can be very invasive (native to japan but has unintentionally spread to everywhere)</li><li>● they exhibit no calcification</li><li>● can spread out over hard surfaces as mats, form spheres or grow upright, either unbranched and finger-like, or branched, with cylindrical or flattened branches</li><li>●</li></ul>
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Charophyceae			
Group	Body form (e.g. motile or not? Unicellular or multicellular? Colonial?)	Life Cycle notes (e.g. sexual? asexual? interesting location notes or propagules?)	Other details (e.g., ecological or taxonomic notes; zygote characteristics)
<i>Spyrogira</i> (genus)	<ul style="list-style-type: none"> <li>• Non-Motile</li> <li>• Multicellular</li> <li>• Not colonial but has colonial structure</li> </ul>	<ul style="list-style-type: none"> <li>• Reproduction done both sexually and asexually</li> <li>• zygospores can withstand harsh environments</li> <li>• Thrives in well-lit nutrient dense habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Forms floating Masses</li> <li>• Indicator of eutrophication</li> <li>• Male and Female haploid cells form diploid zygote</li> <li>• Zygote forms a thick wall for protection and can remain dormant for extended periods of time.</li> </ul>
<p><i>The following two groups are the green algae that most-closely resemble land plants in aspects of cell division and sexual reproduction. Namely: phragmoplast, <b>oogamy</b>, sperm ultrastructure, apical growth, <b>egg retention</b></i></p>			
Coleochaetales (Order)  <i>Coleochaete</i> (genus)	<ul style="list-style-type: none"> <li>• Non-motile</li> <li>• Multicellular organization</li> <li>• Branch filaments with apical growth</li> </ul>	<ul style="list-style-type: none"> <li>• Reproduction is done asexually.</li> <li>• Single sperm (antheridium).</li> <li>• antheridium is multicellular</li> </ul>	<ul style="list-style-type: none"> <li>• Antheridium is motile, while the female egg is not. (oogamous)</li> <li>• The zygote is the only diploid cell within the process.</li> </ul>
Charales (Order)  <i>Chara</i> (genus)	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>○</li> </ul>

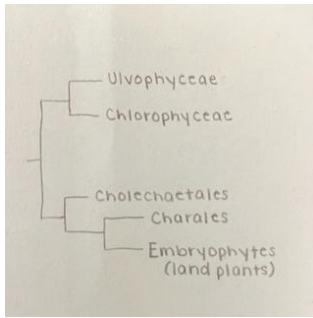
**\*Construct a phylogenetic tree of relationships among the following groups:**

Chlorophytes: 1. **Chlorophyceae** and 2. **Ulvophyceae**

Streptophytes: 3. **Cholechaetales**, 4. **Charales**, 5. **Embryophytes (aka Land Plants)**



## Plant Biology – Green Algae Groups



### \*Note the similarities and differences between green algal groups and the land plants.

Considering the phylogeny above might help. You might also be able to google for some answers.

Which, if any, characteristics appear to be shared ancestral characters between the land plants and any of the other groups:

**Chlorophyceae:** Chloroplasts, sexual reproduction/(zygotic) meiosis,

**Ulvophyceae:** chloroplasts, sexual reproduction/meiosis,

**Charophyceae:** chloroplasts, sexual reproduction/(zygotic) meiosis, cytoskeleton, filamentous growth, oogamy (sometimes)

Which, if any, characteristics appear to be **homoplasies** (products of convergent evolution rather than common ancestry) between the **land plants** and either of the other groups:

**Chlorophyceae:** Flagellated Gametes

**Ulvophyceae:** Morphological Plasticity

**Charophyceae:** Sporopollenin Production