Division: Chlorophyta (green algae)

~ 16,000 species
~ 90% freshwater

General Green Characteristics……

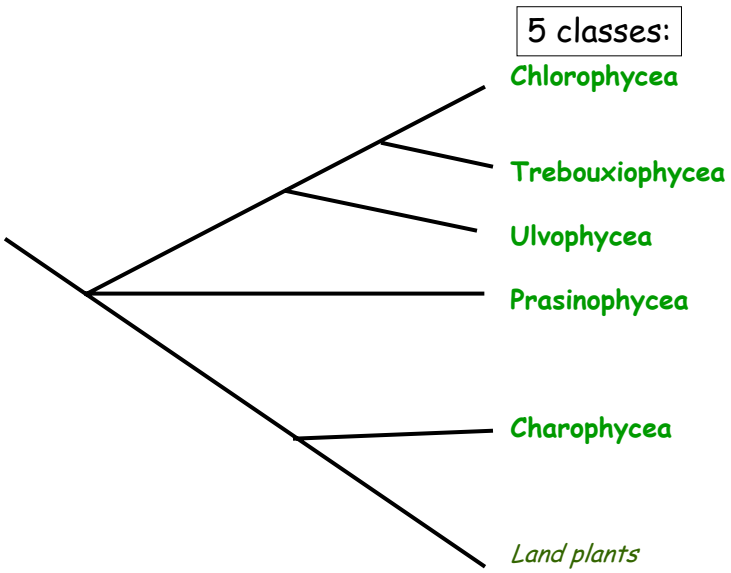
1) Pigments: chl a,b
   carotenoids: B-carotene, lutien, violaxanthin, neoxanthin

2) Chloroplast structure:
   - envelope:
   - thylakoids:

3) Storage product:

4) Flagella:

Phylogenetics of Chlorophyta (morphological, molecular data)



Classes……..

Chlorophycea = freshwater

Trebouxiophycea = freshwater and soil

Ulvophycea = marine macroalgae

Prasinophycea = primarily marine flagellates, some freshwater; modern representatives of earliest green algae

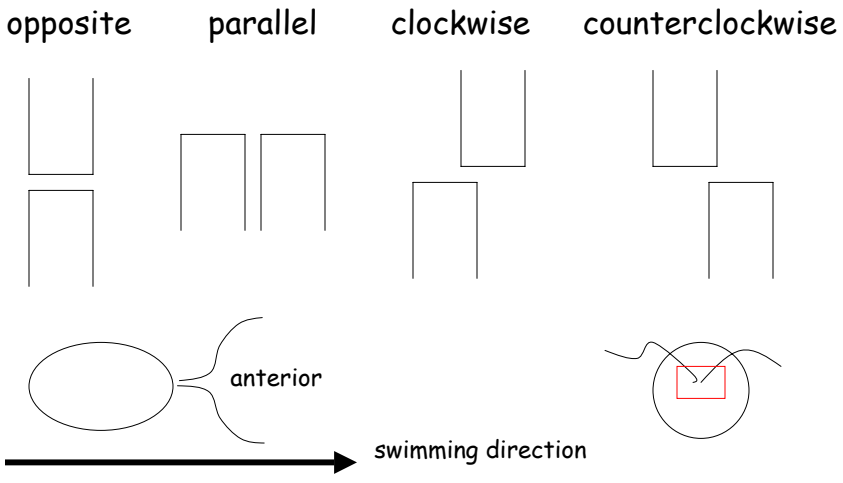
Charophycea = freshwater; all terestrial plants are derived from Charophycean class

Distinguishing among classes based on…

1. How flagella are attached/constructed:
   - basal bodies orientation
   - microtubule roots
2. Cell covering:
   - scales vs. cell wall
3. How cells actually divide:
   - aspects of mitosis and cytokinesis

Distinguishing among classes based on…

1. How flagella are attached/constructed
   - basal bodies orientation
   - microtubule roots



Distinguishing among classes based on…

1. How flagella are attached/constructed
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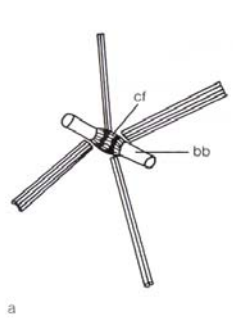
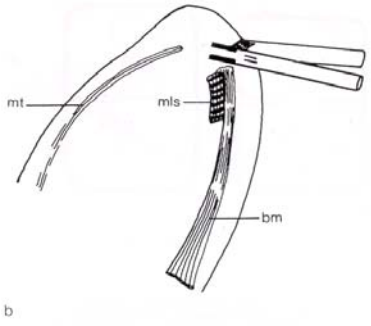
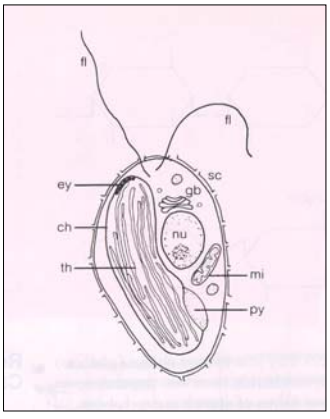




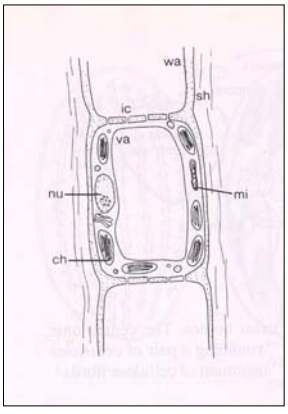
cruciate broad-band

Distinguishing among classes based on…

2. Cell covering
   - scales vs. cell wall



Scales are made of complex polysacharides secreted from golgi

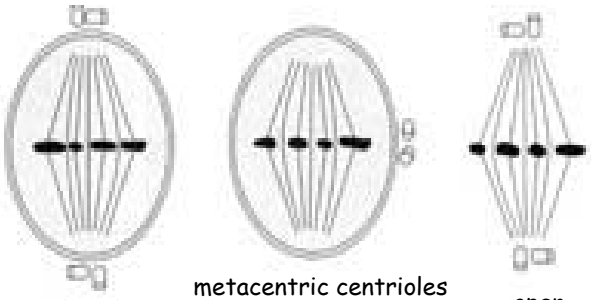


Cell wall = usually cellulose

Distinguishing among classes based on…

3. How cells actually divide:
   (aspects of mitosis and cytokinesis)

- open vs. closed mitotic spindle
- phycoplast vs. phragmoplast
- furrowing vs. cell plate formation in center of cell



closed | metacentric centrioles | open

Distinguishing among classes based on…

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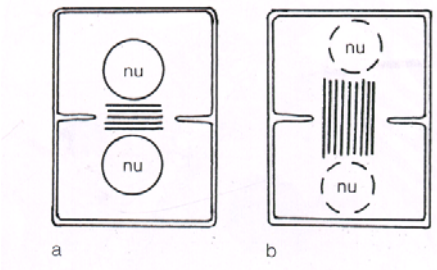

Phycoplast: microtubules parallel to dividing plane

Phragmoplast: double microtubules perpendicular to dividing plane

Distinguishing among classes based on…

3. How cells actually divide:
   (aspects of mitosis and cytokinesis)

- open vs. closed mitotic spindle
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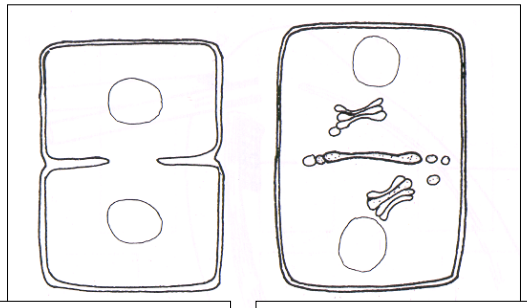


furrowing = most algae

cell plate formation = a few algae and land plants

Morphology

Chlorophyta……

- easiest division to identify visually
- usually bright, grass-green color

Except……

Snow algae

Trentepohlia parasitic on Monterey Cypress

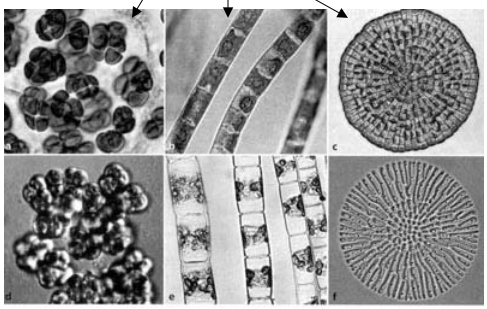
Dunaliella

Morphology

For classes……..
……any easy "rules" using external thallus morphology?

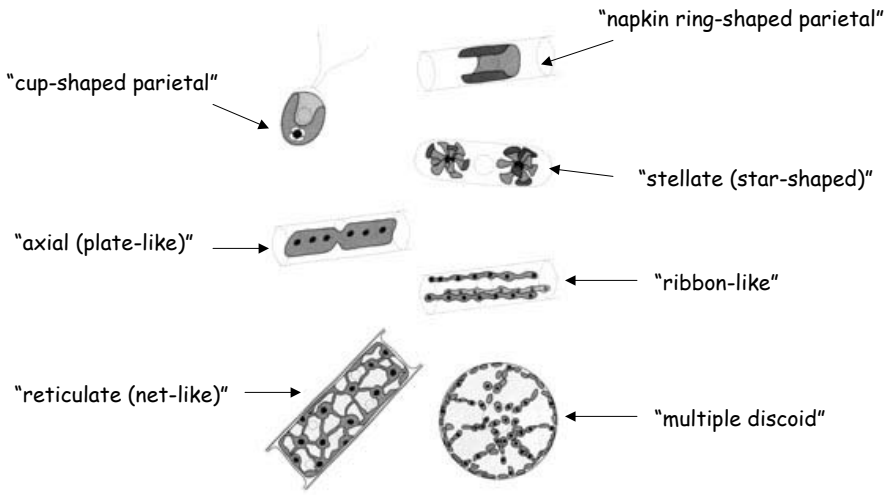
- Prasinophyceans are all unicells, but…

Charophyceans



Chlorophyceae Ulvophyceae Ulvophyceae

Diversity in chloroplast shape……..



Algal Life Cycles

General Terms……

Isogamy – sexual fusion between flagellated gametes that are similar in size and shape

Anisogamy – sexual fusion between flagellated gametes of distinctly different sizes

Oogamy – sexual fusion between a flagellated gamete (sperm) and non-flagellated gamete (egg)

Sporophyte – spore-producing phase in alternation of generations

Gametophyte – gamete- producing phase in alternation of generations

Green Algal Life Cycles

Three main patterns:

1) Haplontic

2) Diplontic

3) Alternation of Generations
   - Isomorphic
   - Heteromorphic

Green Algal Life Cycles

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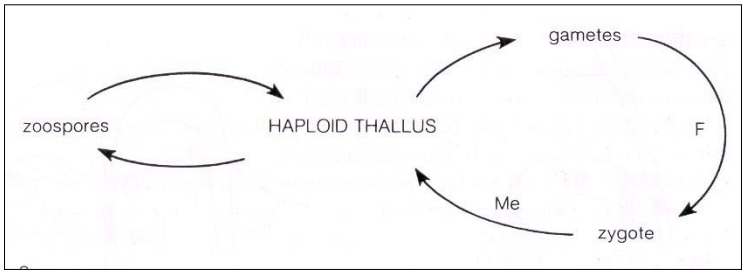

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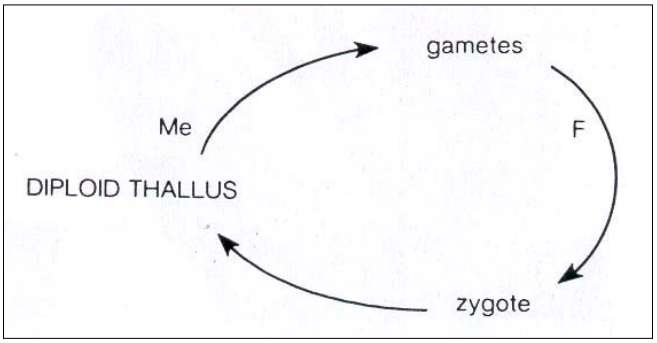
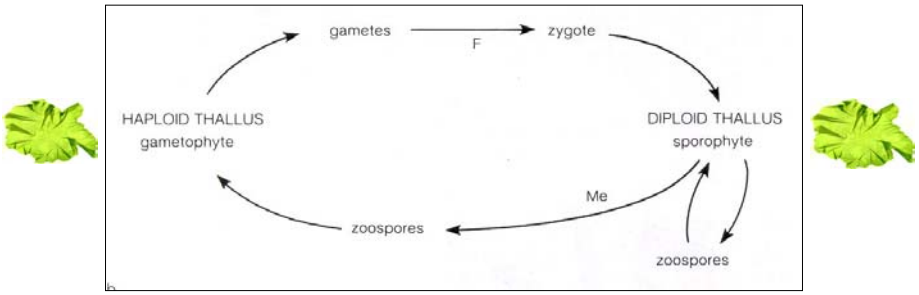


"animal-like" life history

Green Algal Life Cycles

Three main patterns:

1) Haplontic
2) Diplontic
3) Alternation of Generations
   - Isomorphic
   - Heteromorphic



Green Algal Life Cycles

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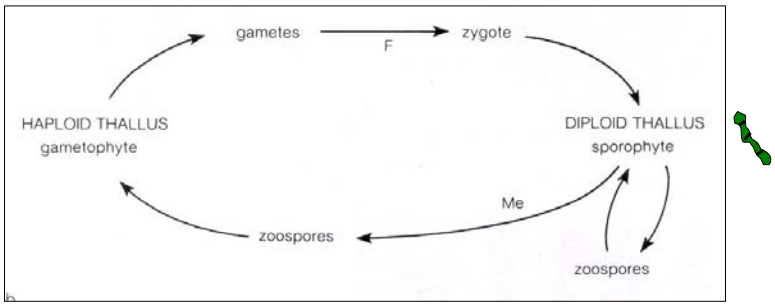
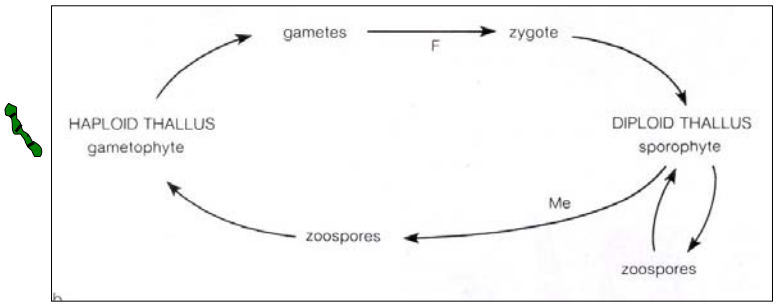


"haplodiplontic"

Green Algal Life Cycles

Three main patterns:

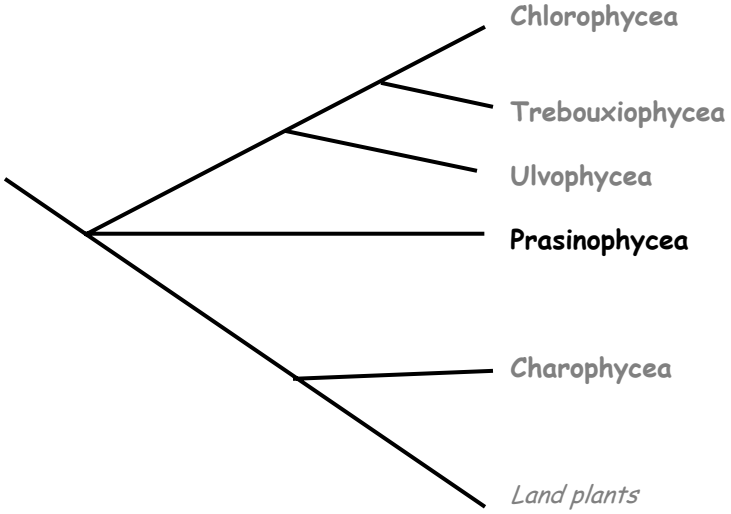
1) Haplontic
2) Diplontic
3) Alternation of Generations
   - Isomorphic
   - Heteromorphic



"diplohaplontic"

Chlorophyte Diversity……..

5 classes:



Class Prasinophyceae:

1. How flagella are attached/constructed:
   - basal bodies orientation = variable
   - microtubule roots = variable
2. Cell covering:
   - scales vs. cell wall = scales
3. How cells actually divide:
   - spindle = open or closed
   - microtubule organization = phragmoplast or phycoplast
   - division by = furrow

Class Prasinophyceae:

✓modern representatives of ancestral green

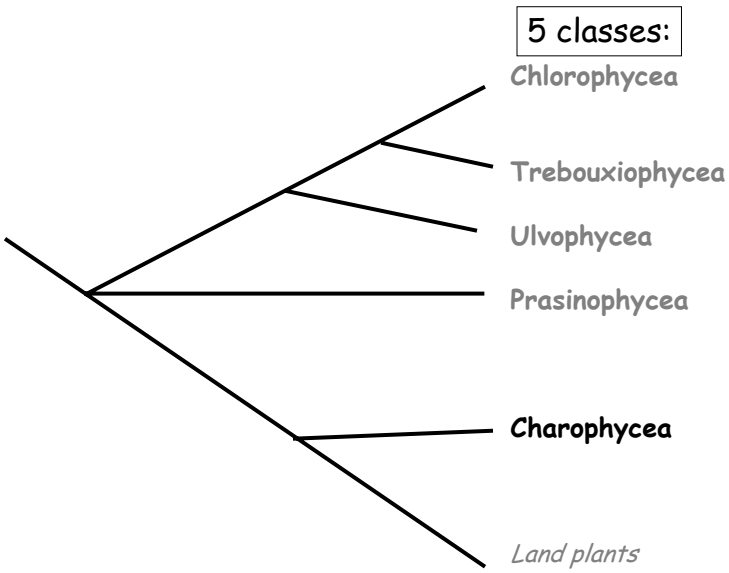
✓unicells, mostly marine flagellates

✓ one plastid with one pyrenoid

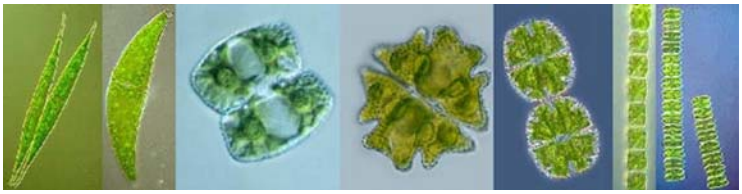
✓ haplontic, isogamous reproduction

✓ mostly asexual

Chlorophyte Diversity……..

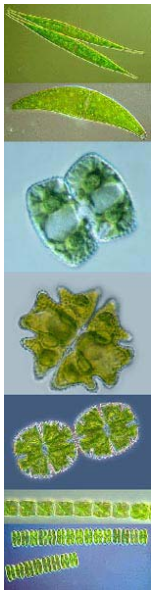


Class Charophyceae:



1. How flagella are attached/constructed:
   - basal bodies orientation = parallel
   - microtubule roots = broad band
2. Cell covering:
   - scales vs. cell wall = wall
3. How cells actually divide:
   - spindle = open
   - microtubule organization = phragmoplast
   - division by = furrow

Class Charophyceae:



✓ most closely related to terrestrial plants

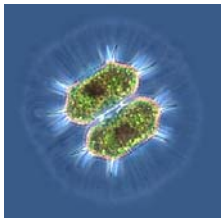
✓usually unicells or filaments, but sometimes colonies and more complex forms

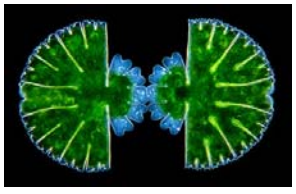
✓ freshwater

✓ haplontic, oogamous reproduction

✓ dormant zygotes

Class Charophyceae:

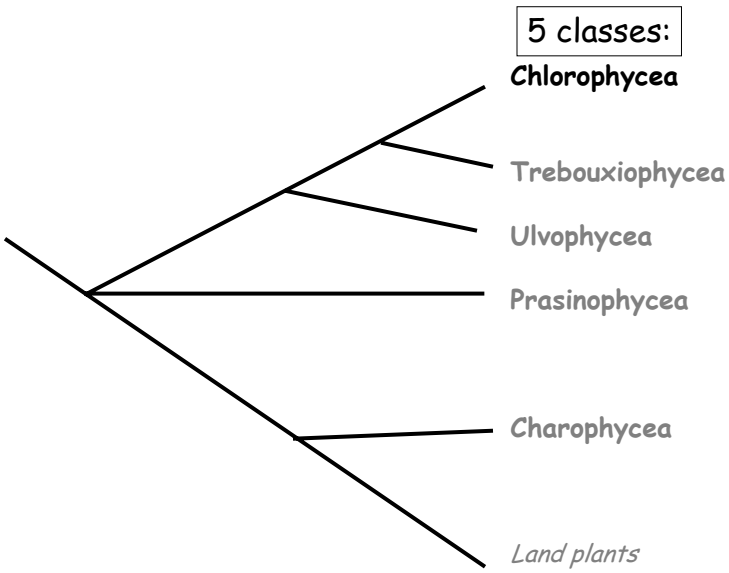




desmids……..

- 2 semi-cells that are mirror images
- asexual fragmentation; sexual conjugation
- new half is a different age
- movement through mucilage secretion

Chlorophyte Diversity……..



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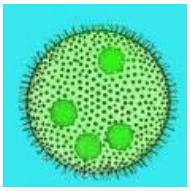
Class Chlorophycea:



1. How flagella are attached/constructed:
   - basal bodies orientation = clockwise
   - microtubule roots = cruciate
2. Cell covering:
   - scales vs. cell wall = wall
3. How cells actually divide:
   - spindle = closed
   - microtubule organization = phycoplast
   - division by = furrowing

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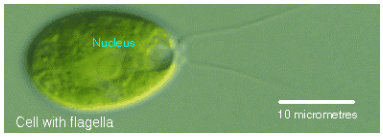
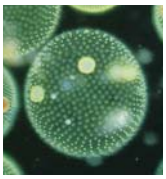
Class Chlorophycea:

- ✓ 7000+ spp
- ✓mostly freshwater
- ✓unicells, colonies, coenocytes, filaments,
- ✓ haplontic life history, with "hypnozygote" = thick walled resting stage
- ✓ isogamous, anisogamous, and oogamous species

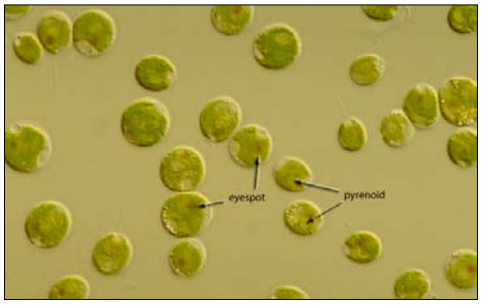
Celebrity genera:

Chlamydomonas, Volvox, Dunaliella





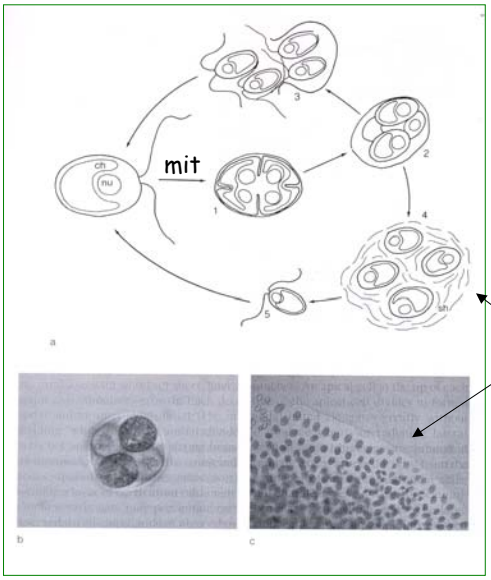
Chlamydomonas- algal lab rat



- cup-shaped chloroplast, orange eyespot
- scientists sequenced and mapped genome in 2003
- used as a model to determine how gene expression works
- use mutations to determine where genes are on chromosomes

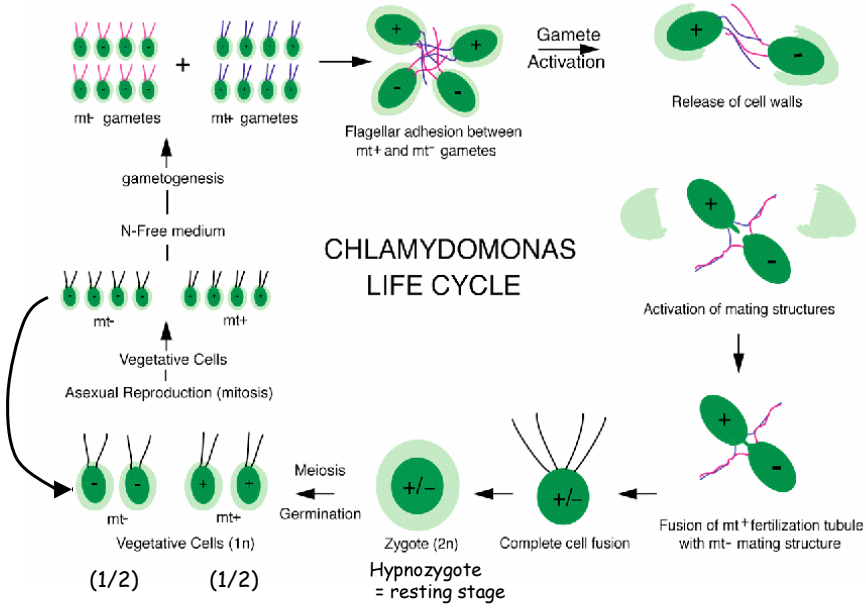
Chlamydomonas life history……..

usually asexual…

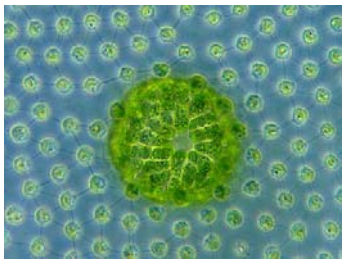


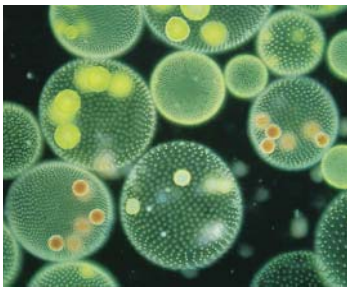
"palmaloid stage" →formed under moist but not fluid conditions

sexual reproduction in unfavorable conditions…….



Volvox……..





• spherical colonies of 500 – 40,000 cells

• each colony contains a large number of somatic cells and a small number of reproductive cells

Volvox life history…

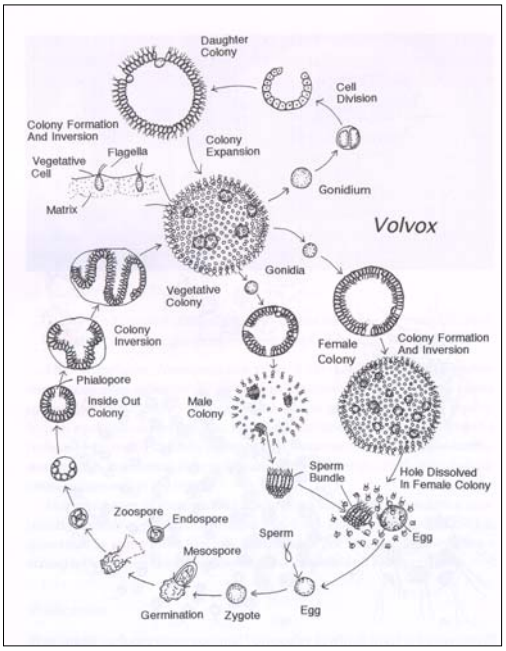
• oogamous

• haplontic

•gonidium = a cell that divides to form a daughter colony

•meiospore = spore formed from meiosis

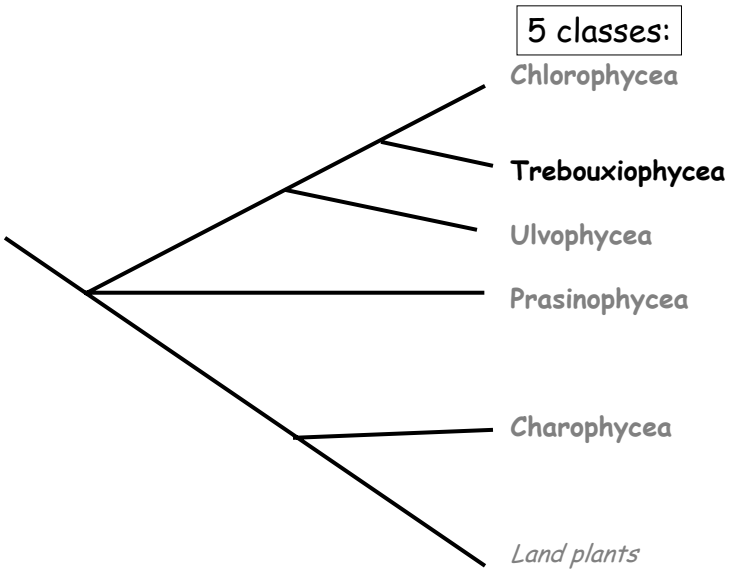
•zoospore = spore with flagella



Dunaliella……

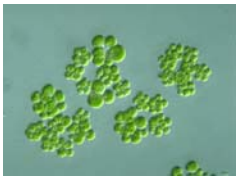
- common in salt ponds
- packed with beta-carotene to protect from UV irradiance
- commercial value (beta-carotene) = used for food coloring and in pharmaceuticals

Chlorophyte Diversity……



Class Trebouxiophycea:



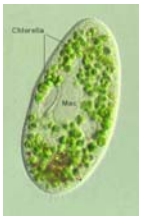
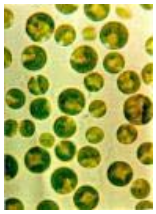


1. How flagella are attached/constructed:
   - basal bodies orientation = counterclockwise
   - microtubule roots = cruciate
2. Cell covering:
   - scales vs. cell wall = wall?
3. How cells actually divide:
   - spindle = closed; metacentric
   - microtubule organization = phycoplast
   - division by = furrow

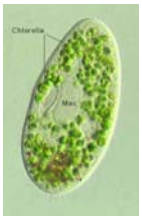
Class Trebouxiophycea:

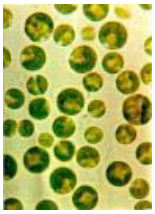
- ✓ freshwater and terrestrial algae
- ✓ unicells, filaments, blades

Celebrity genus: ***Chlorella***


Chlorella……





- unicellular

- endosymbiont in freshwater animals;

- used by Melvin Calvin to investigate carbon fixation in plants (Calvin cycle)

- marketed as a dietary supplement

Health Benefits:

- •Help your body remove the heavy metals and other pesticides in your body
- •Improve your digestive system, including decreasing constipation
- •Focus more clearly and for greater duration
- •Balance your body's pH
- •Help Eliminate bad breath