

Freshwater Algae Workshop
Oct 9, 2026

Freshwater Algae in Northwest Washington

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What is This Slime in My Water?

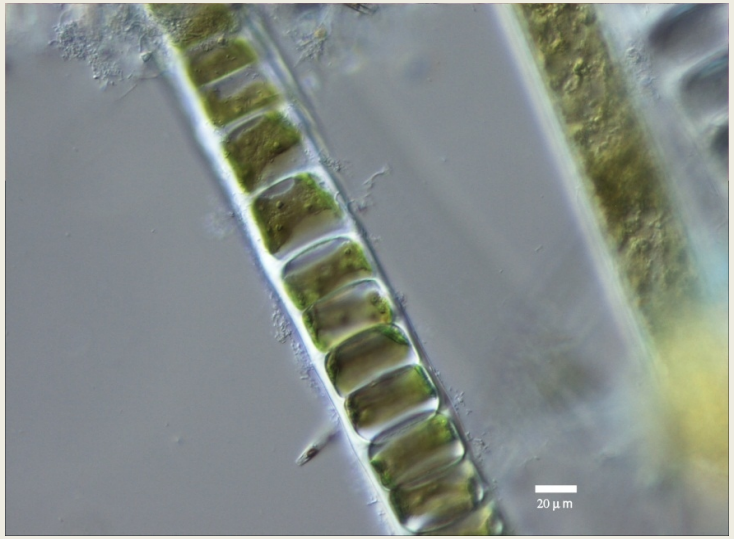
- Most taxonomic classifications currently place algae in four different kingdoms:
  - Bacteria
  - Chromista
  - Plantae
  - Discoba (formerly Protozoa)
- Sources of algal nomenclature:
  - AlgaeBase (http:/www.algaebase.org)
  - Integrated Taxonomic Information System

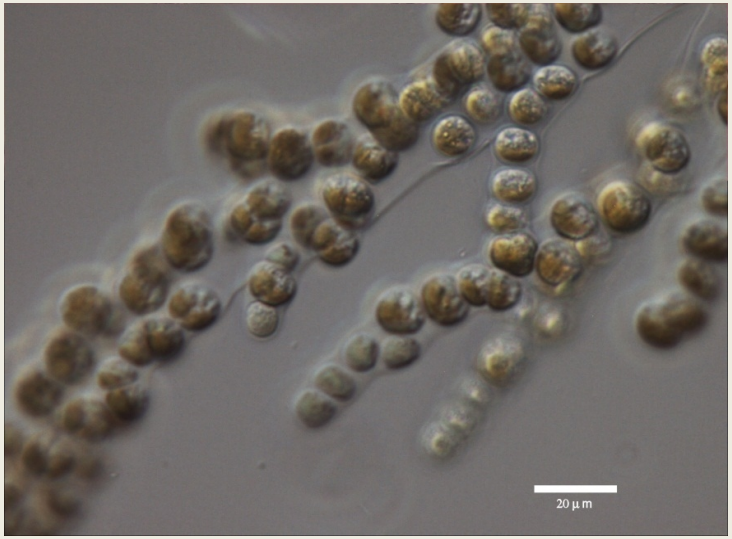
    (ITIS; www.itis.gov)

Kingdom Bacteria (Blue-Green Algae)

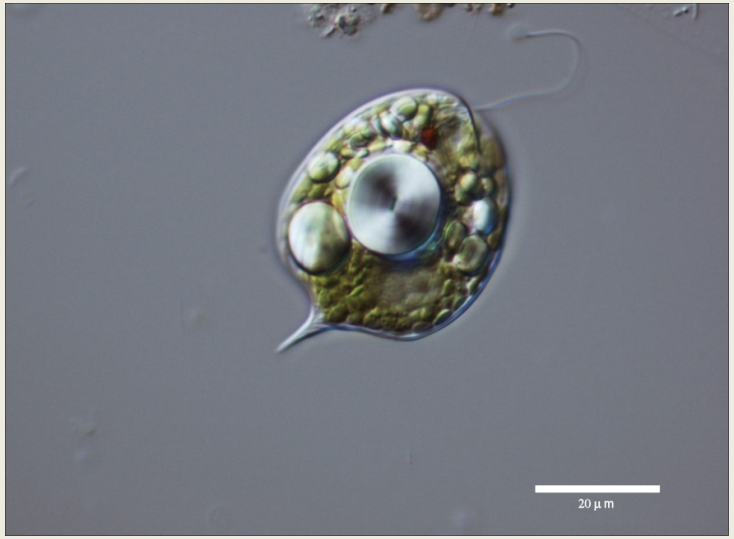


Kingdom Plantae (Green Algae; Desmids, Red Algae)

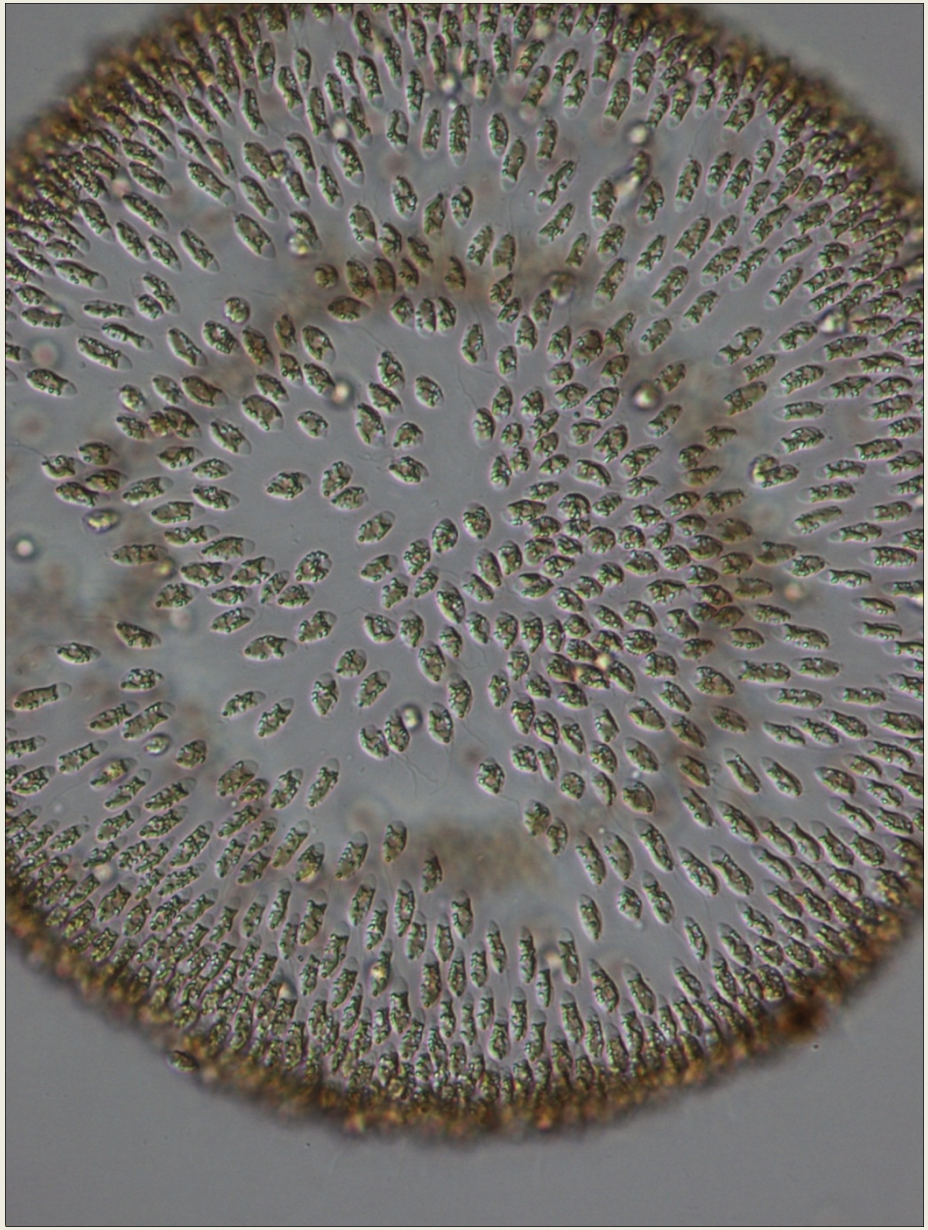


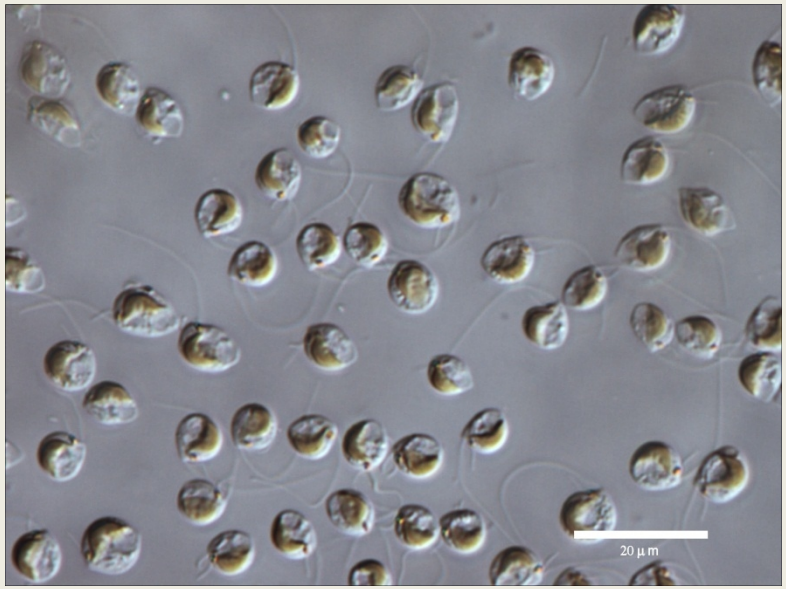


Kingdom Chromista (Golden/Yellow-Green Algae; Cryptomonads; Diatoms, Dinoflagellates)



Kingdom Discoba (Euglenoids)





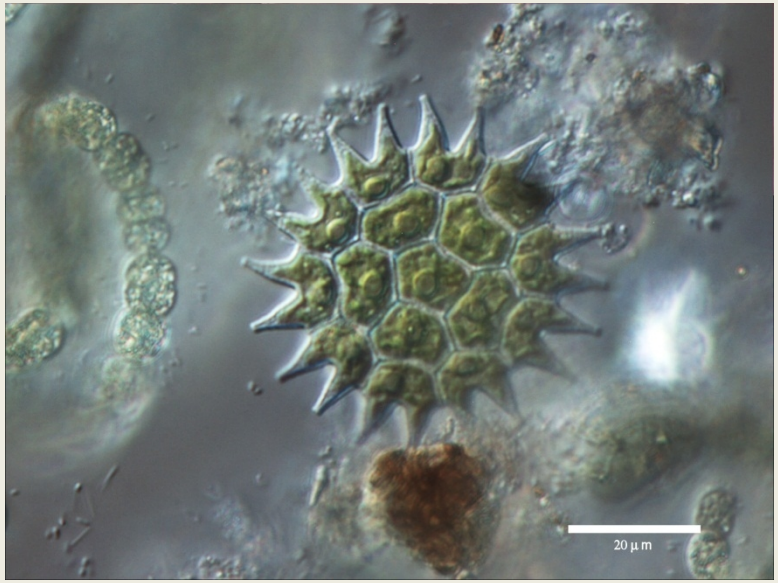
Uroglena by any other name would smell as bad!

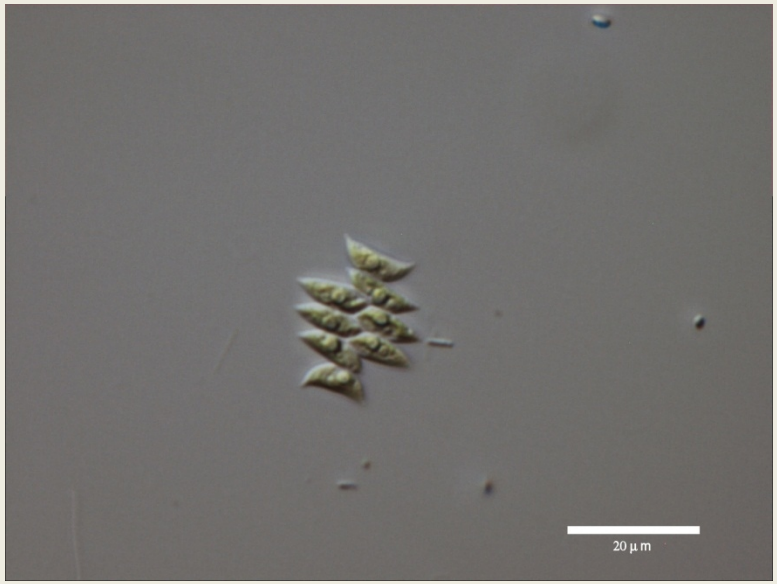
Kingdom:	Chromista
Phylum:	Heterokontophyta
Class:	Chrysophyceae
Order:	Chromulinales
Family:	Chromulinaceae
Genus:	*Uroglenopsis*
Species:	*americana*

Anabaena crassa or *Dolchospermum crassum*?

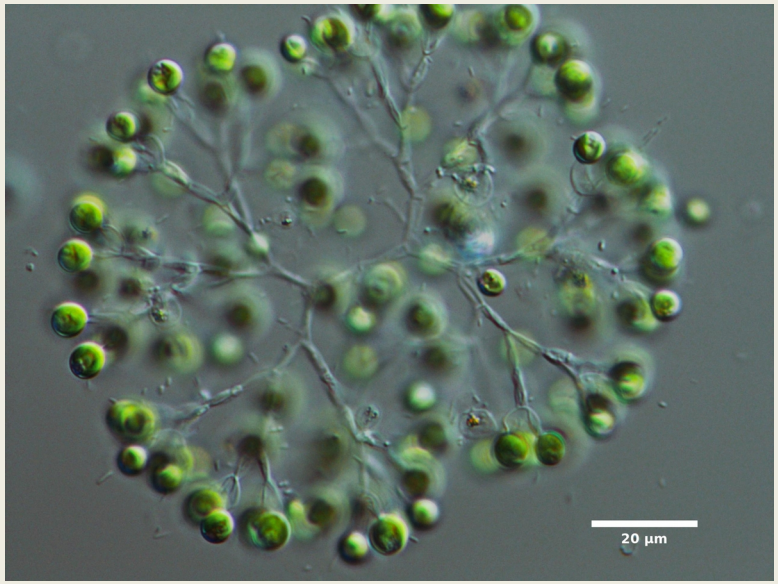


Pediastrum boryanum or *Pseudopediastrum boryanum*?





Scenedesmus obliquus, *Acutodesmus obliquus*, or *Tetradesmus obliquus*?



Dictyosphaerium pulchellum or *Mucidosphaerium pulchellum*

So … Why Bother With Names?

- The scientific name is not important if you just need to know how much algae is present
  - Measure biomass (chlorophyll, AFDW, etc)
- And we usually don't need species names unless we have with specific issues like toxicity
  - Toxic cyanobacteria blooms are a major issue
  - Certain algal species are indicators of acidic runoff, high concentrations of metals, high levels of organics or sewage waste, etc
- But knowing "who is there" provides information about the ecology of the lake, pond, wetland, stream, waterfall, or other freshwater site
  - Nearly all algae are "cosmopolitan" so their distribution is controlled by habitat, rather than being limited by isolation

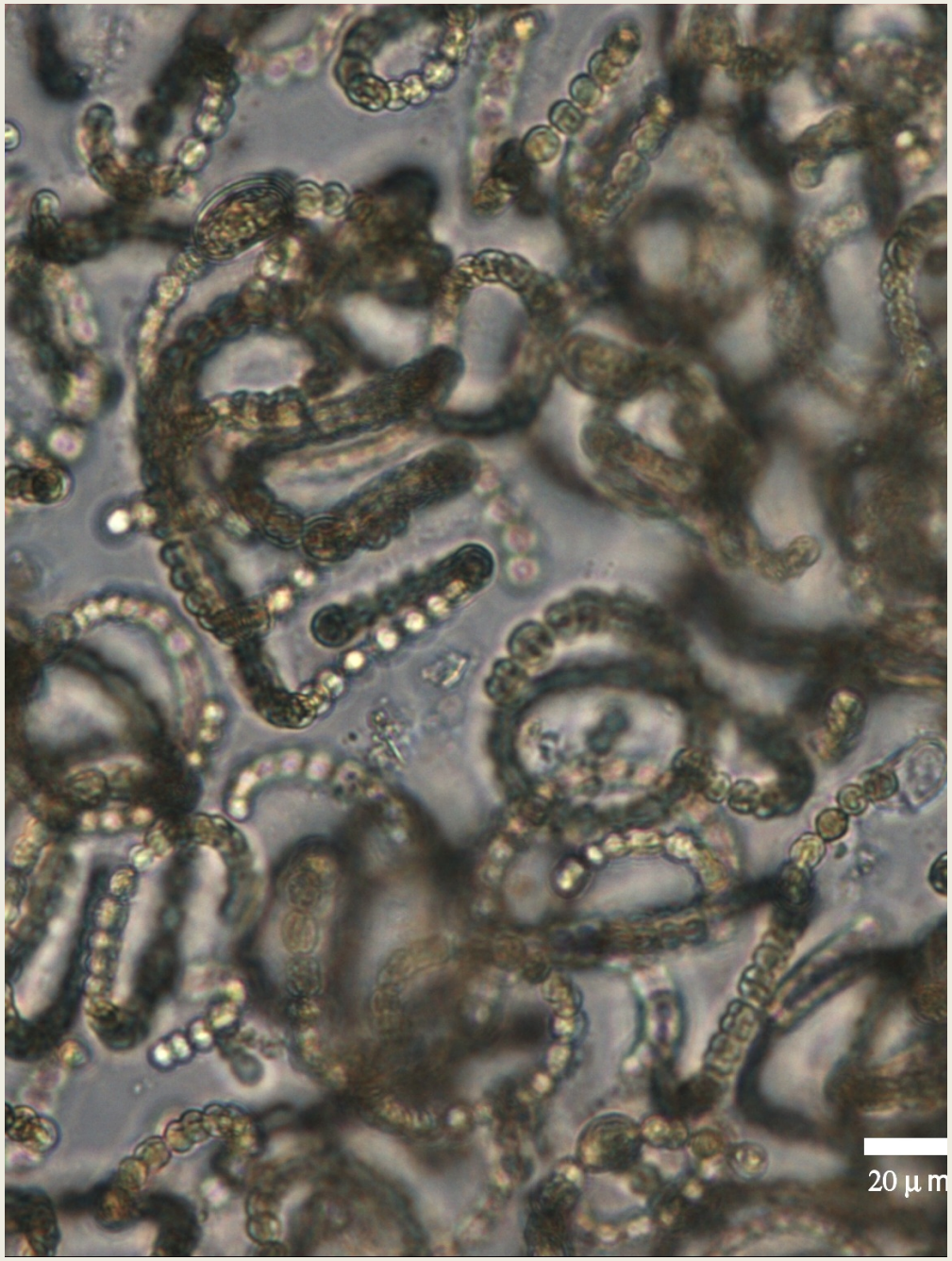
Taxonomists/Geneticists Change Names Based on New Information

	ITIS*	AlgaeBase*
Kingdom	Chromista	Chromista
Phylum	Chrysophyta	Heterokontophyta
Class	Chyrsophyceae	Chrysophyceae
Order	Ochromonadales	Synurales
Family	Synuraceae	Mallomonadaceae
Genus	*Synura*	*Synura*
Species	*peterseni*	*petersenii*

*Integrated Taxonomic Information System (https://www.itis.gov/); AlgaeBase (https://www.algaebase.org/)

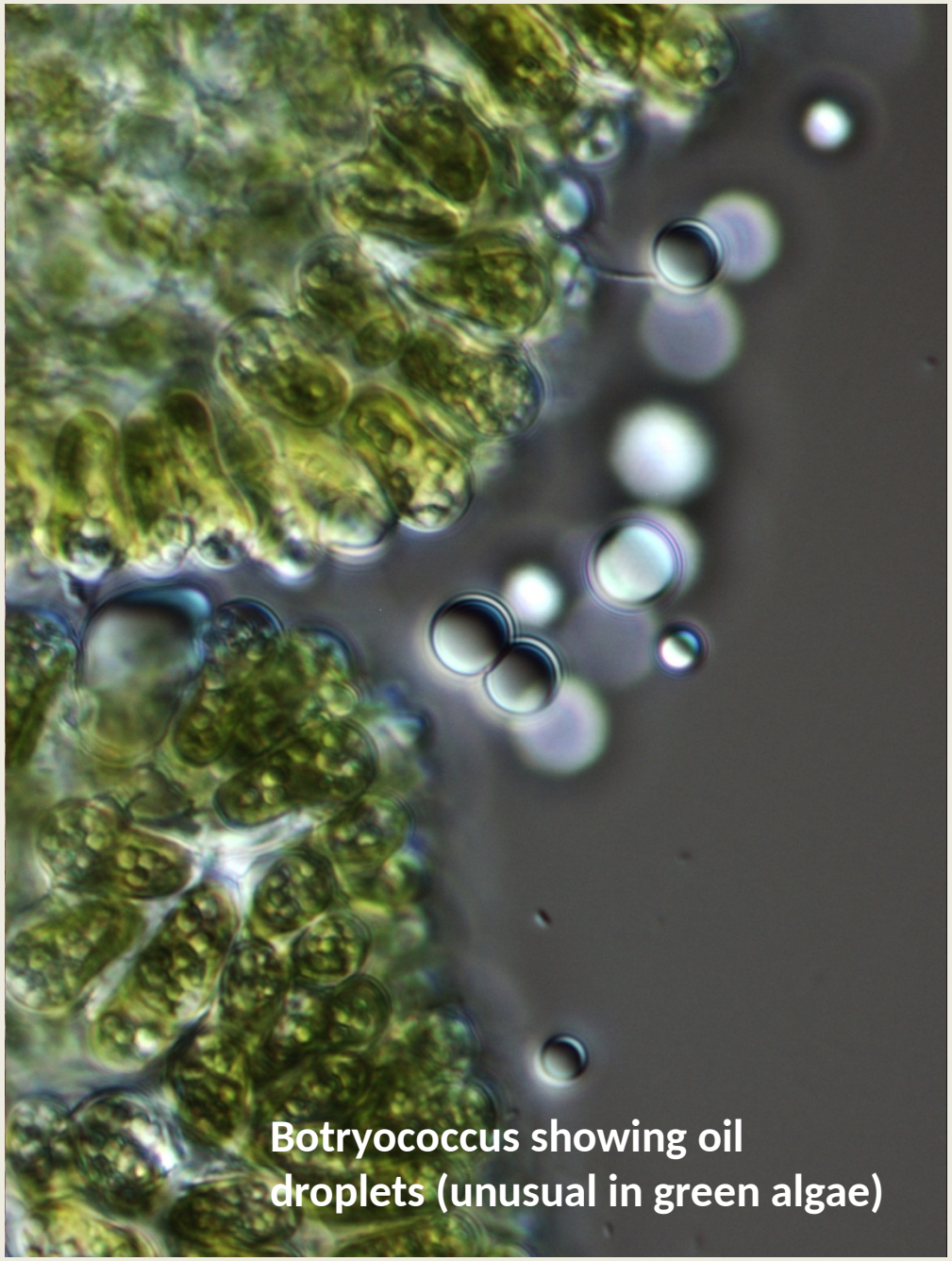


Animal, Vegetable, or Mineral?



Blue-Green Algae (Cyanobacteriophyta)

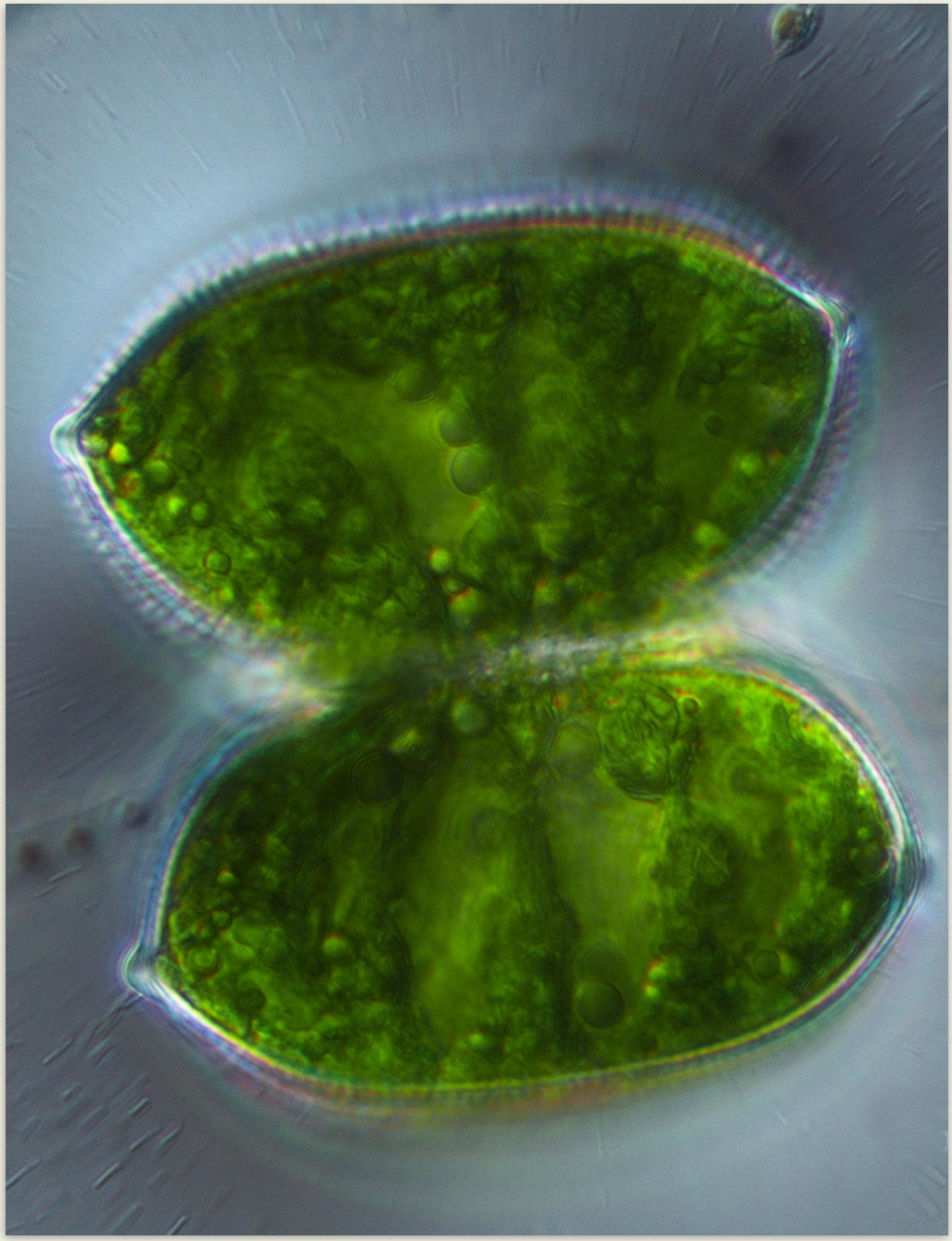
- No chloroplast, pyrenoid, nucleus, flagella
- Usually in filaments or colonies; rarely solitary
- Color might be blue-green … or bright green, gray, blue, red, or even purple
- Movement by gliding (no flagella)
- Often very slimy!
- May form toxic or otherwise noxious blooms



Botryococcus showing oil droplets (unusual in green algae)

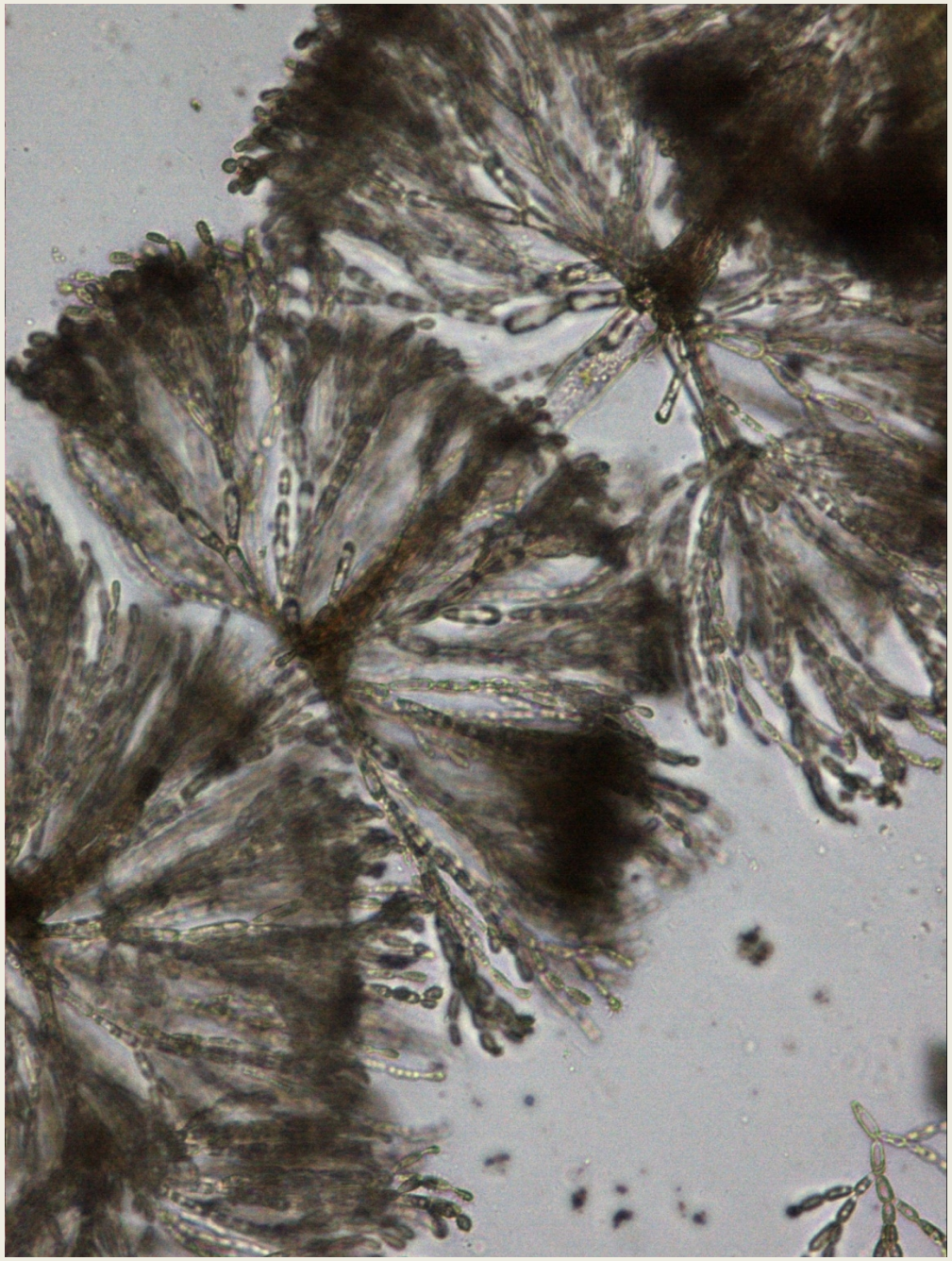
Green Algae (Chlorophyta)

- Chloroplast is often bright green
- Cells can also be brown, orange, yellow, or red … sometimes in one species
- Starch is produced inside the chloroplast, often in conjunction with pyrenoids
- Most have motile cells during some part of the life cycle (2 or 4 equal length flagella)



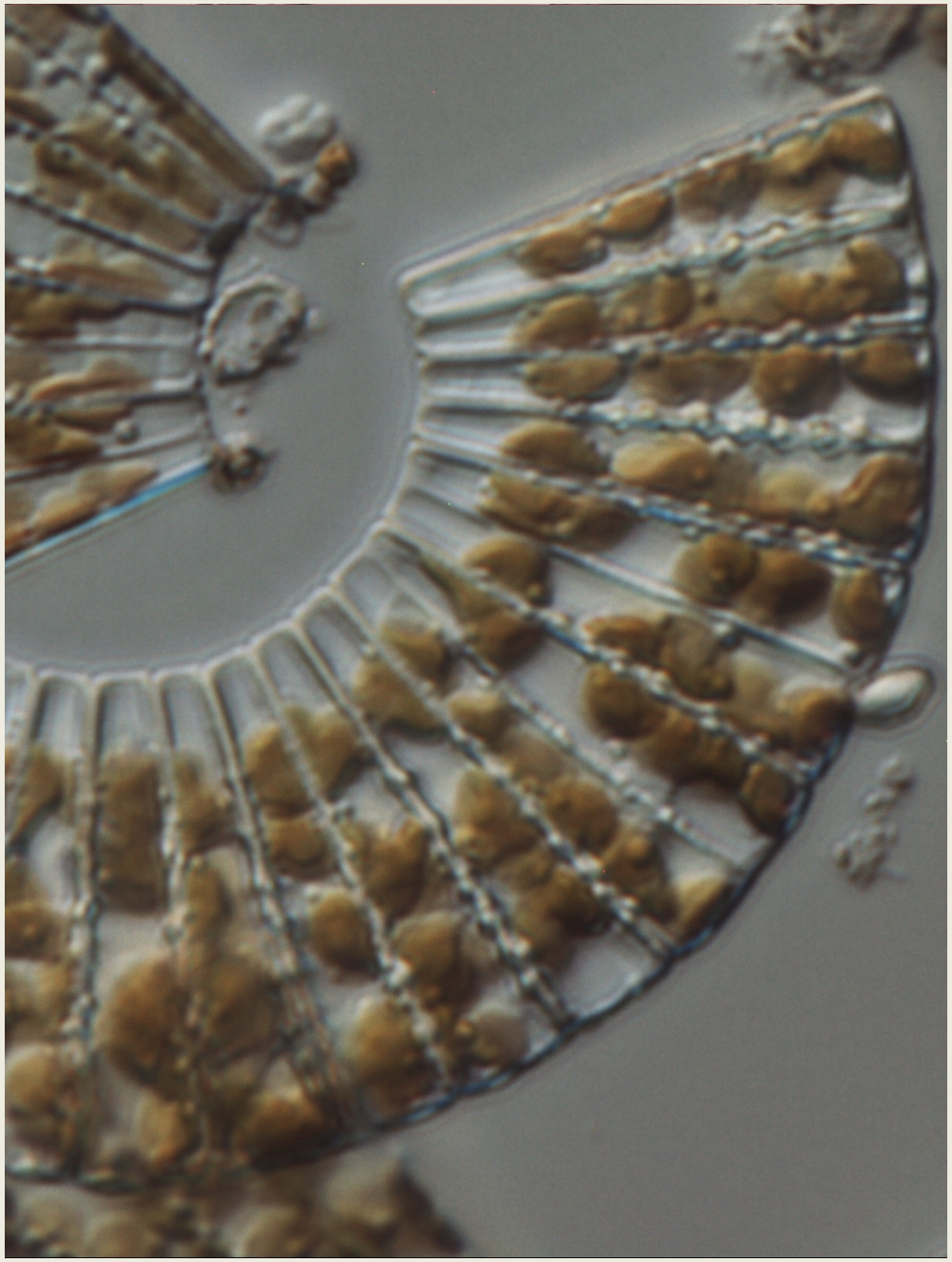
Desmids (Charophyta)

- Closely related to green algae – separation is based on features not usually present in sample zygote formation
- Most desmids have large cells consisting of two mirror-image "semi-cells"
- Desmids are particularly abundant in clean, soft-water lakes, ponds, and wetlands with high DOC (e.g., sphagnum bogs)



Red Algae (Rhodophyta)

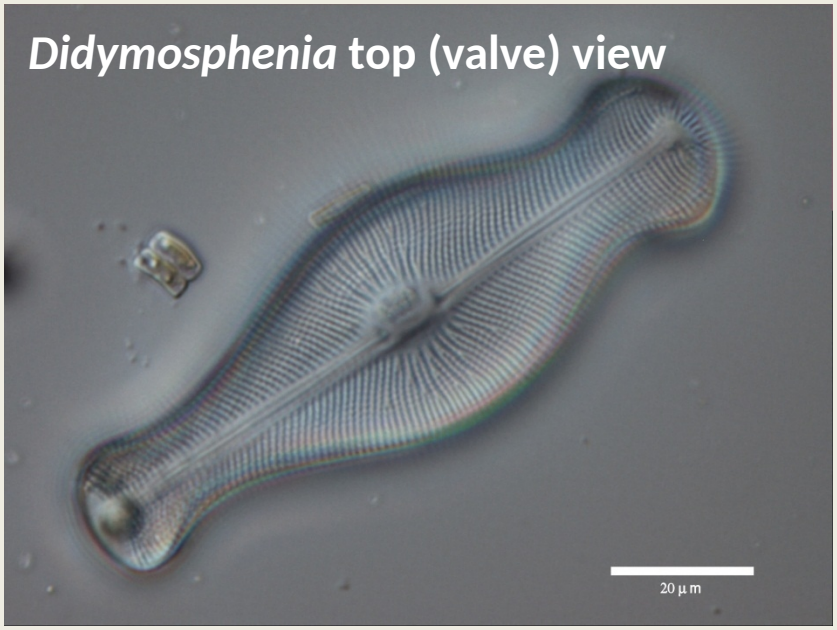
- Most red algae are marine
- Oldest form of “eukaryotic” algae (cells with chloroplasts, nucleus, etc.)
- The chloroplast resembles cyanobacteria cell
- May be red, but may also be blue or olive-green
- Common in cold, clear mountain streams

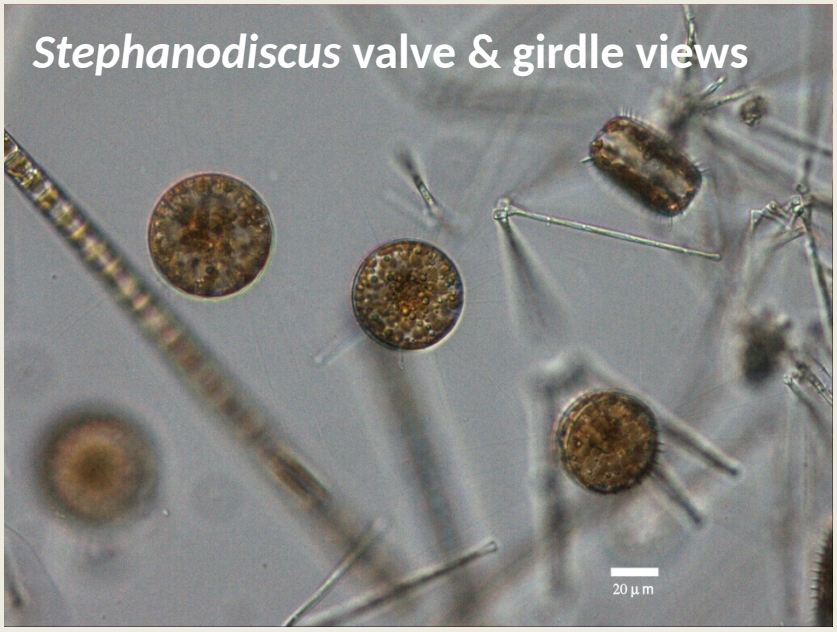


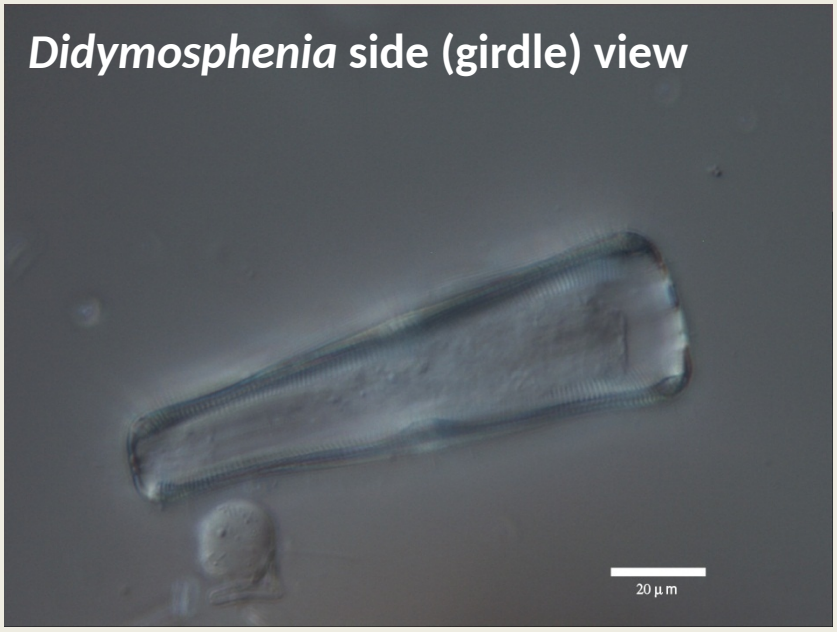
Diatoms are Easy … or Not! (Bacillariophyta)

- Diatom cells are enclosed in a silica case (frustule), which makes them easy to identify and “diatoms”
  - Taxonomy is based on the shape and ornamentation on the frustule ..not easy!
- Chloroplasts are bright golden brown
- Cells move by gliding (no flagella)
- Most store oil as a food reserve

- Diatoms come in two basic shapes when viewed from the top (valve view):
  - round (centric)
  - elongate (pennate)
- The cells can be solitary or linked into filaments







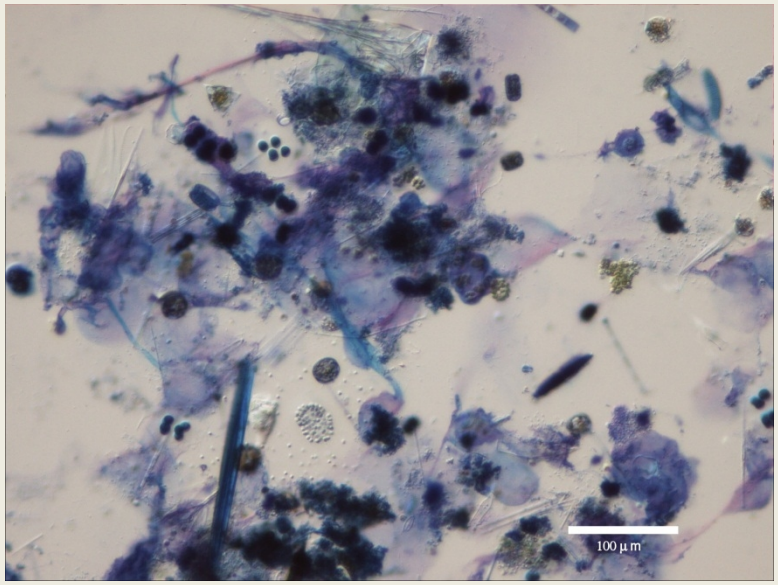
Cyclotella fibers (Lake Whatcom)



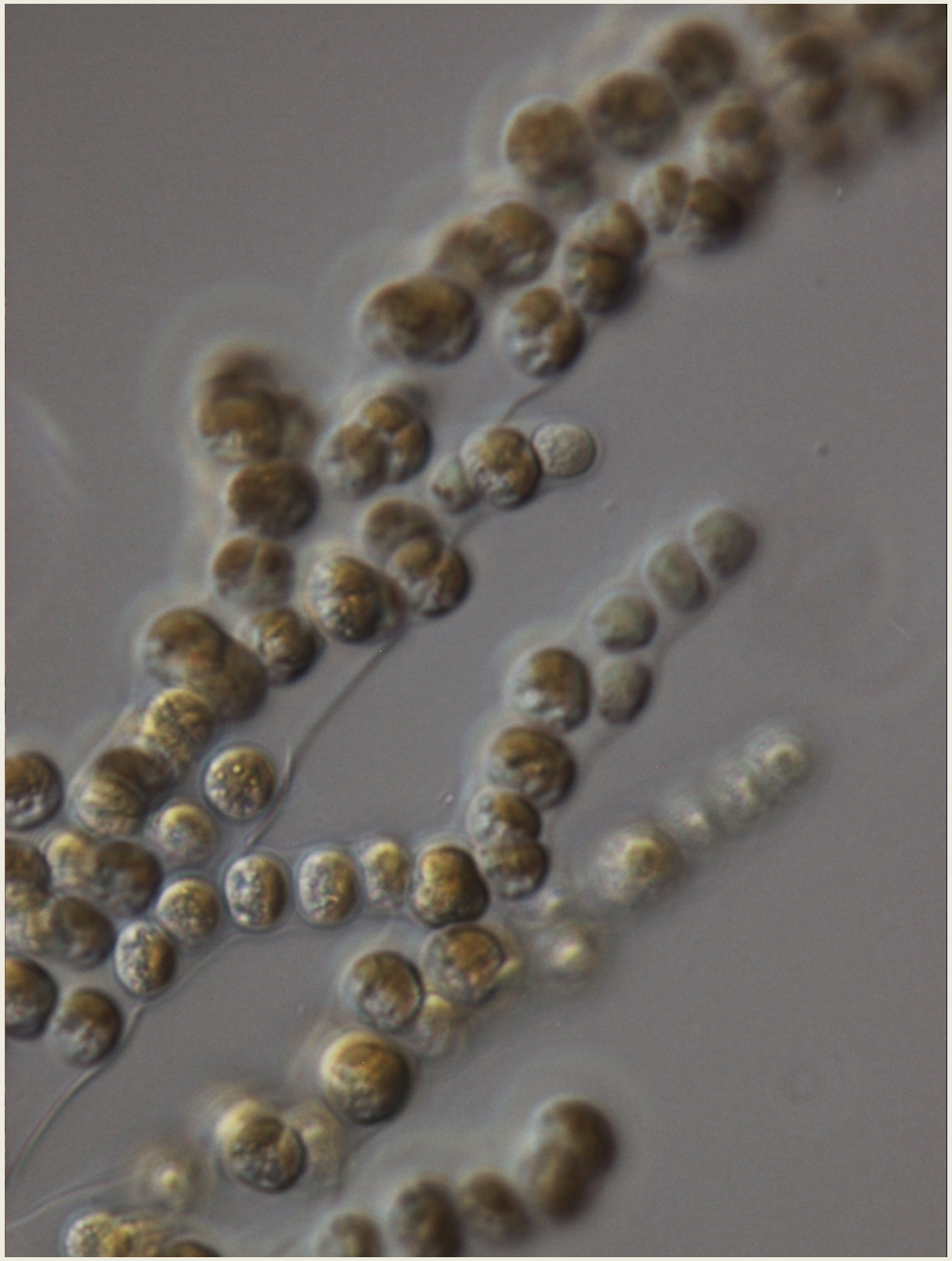
- Diatoms are very common in most natural water sources, especially in spring/early summer
- The cells may exude sticky fibers or (and) slime, causing filter clogging
- Many species are associated with taste/odor problems



Cyclotella slime (Lake Whatcom)

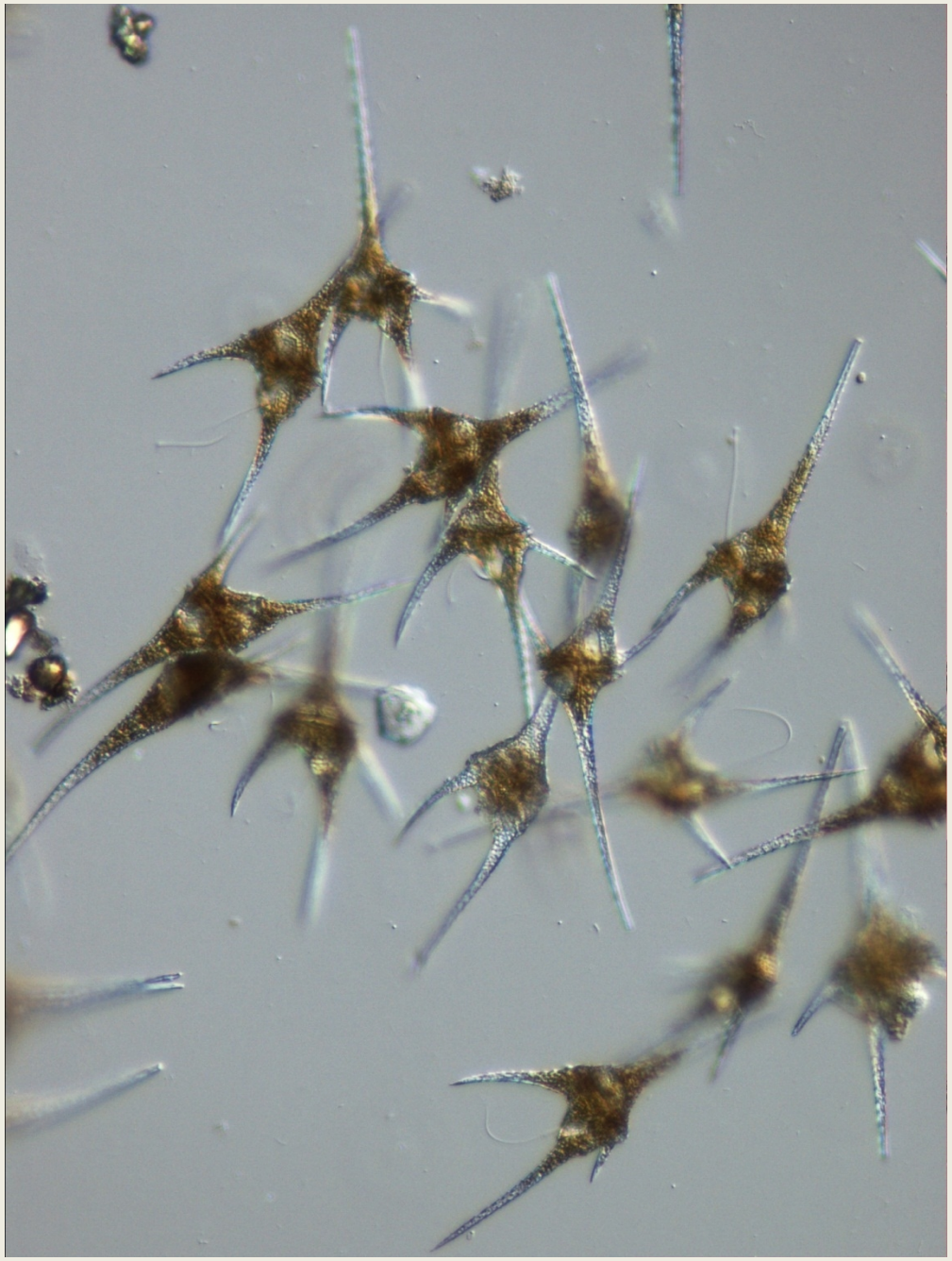


Lake Whatcom slime - *Aphanocapsa*, *Aphanothece*, *Cyclotella*, *Synedra*



Meet the Goldens (Chrysophyceae, etc.)

- Close relatives of diatoms (Kingdom Chromista)
- Most prefer soft water (low dissolved solids)
  - High diversity in Pacific NW
- Motile cells have two unequal flagella
- Chloroplast is golden brown
- Cells do not produce starch (don’t stain with Lugol’s iodine)



The Armored Brigade (Dinoflagellata)

- All species are solitary motile cells
- Cells have two flagella: one trailing and one that circles the cell
- Many have thick sutured plates covering the cell
- Many species are not photosynthetic
- Marine species associated with toxicity



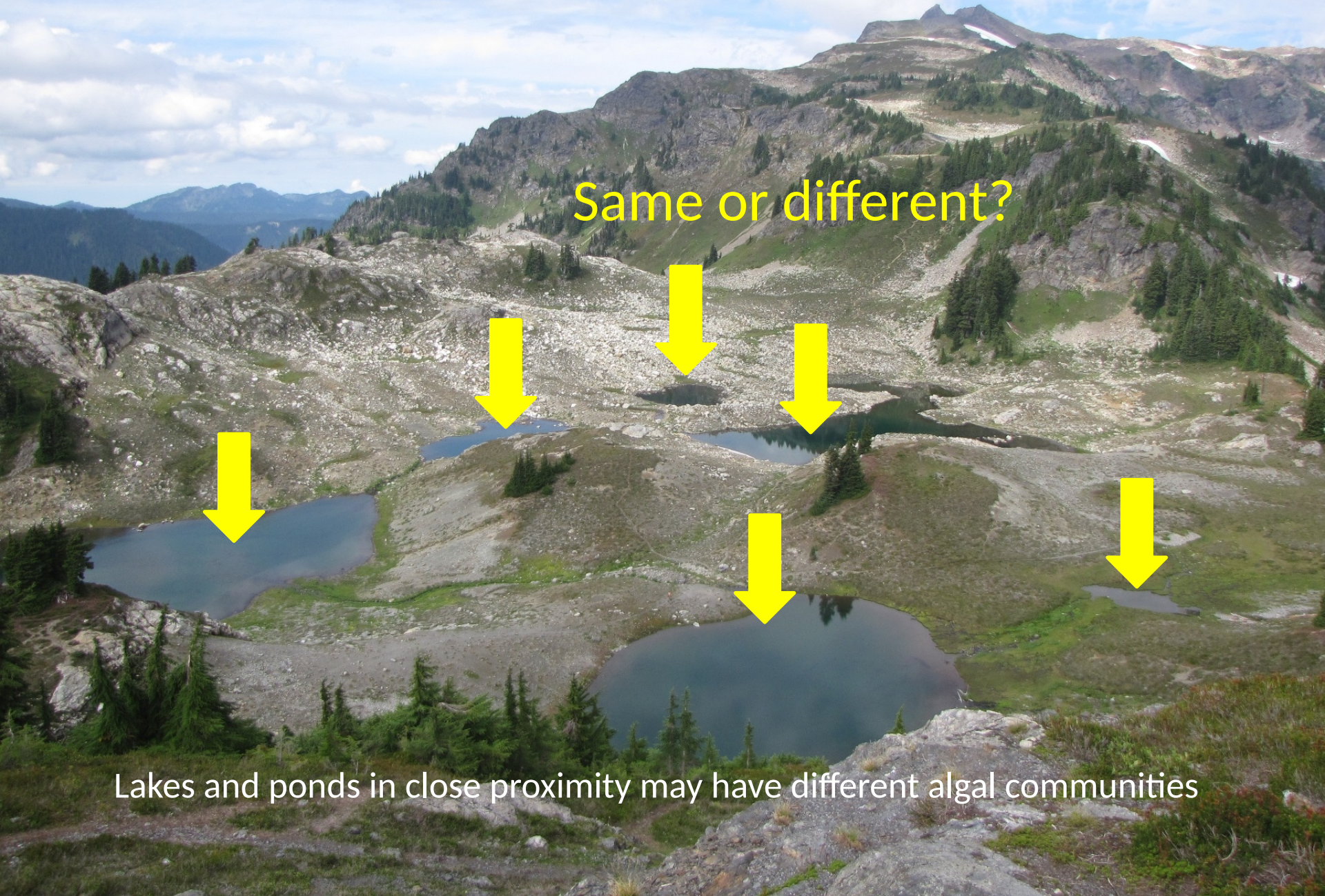
The Original Plant/Animal (Euglenophyta)

- Mostly solitary motile cells
- Single emergent flagellum
- Bright red eye eyespot
- All require some type of nutritional supplement (vitamin B_{12}, organic carbon)
- Most are bright green, but can also be red or brownish; some lack chloroplasts

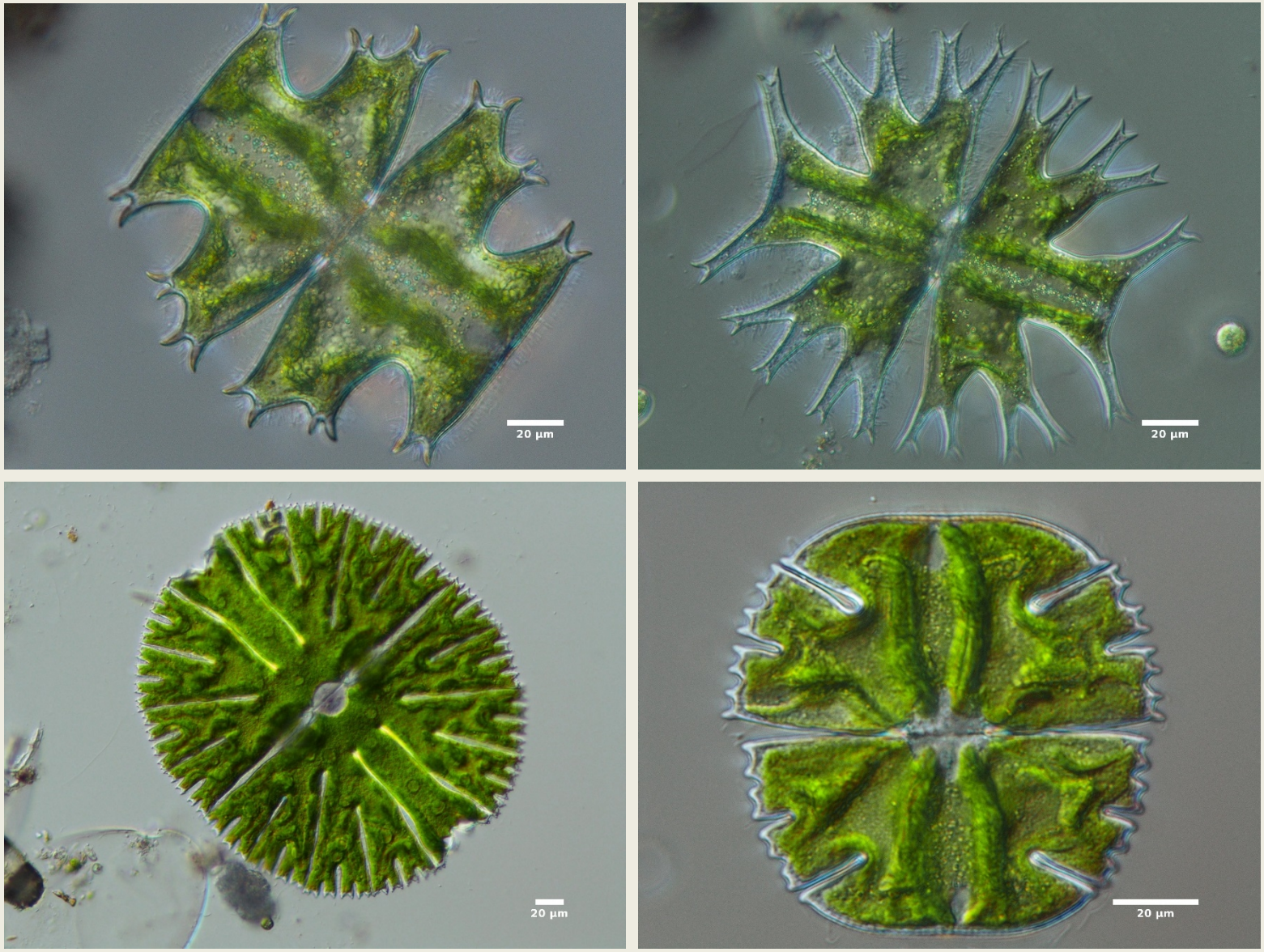
What Distinguishes Algae in Northwest Washington Lakes and Streams?



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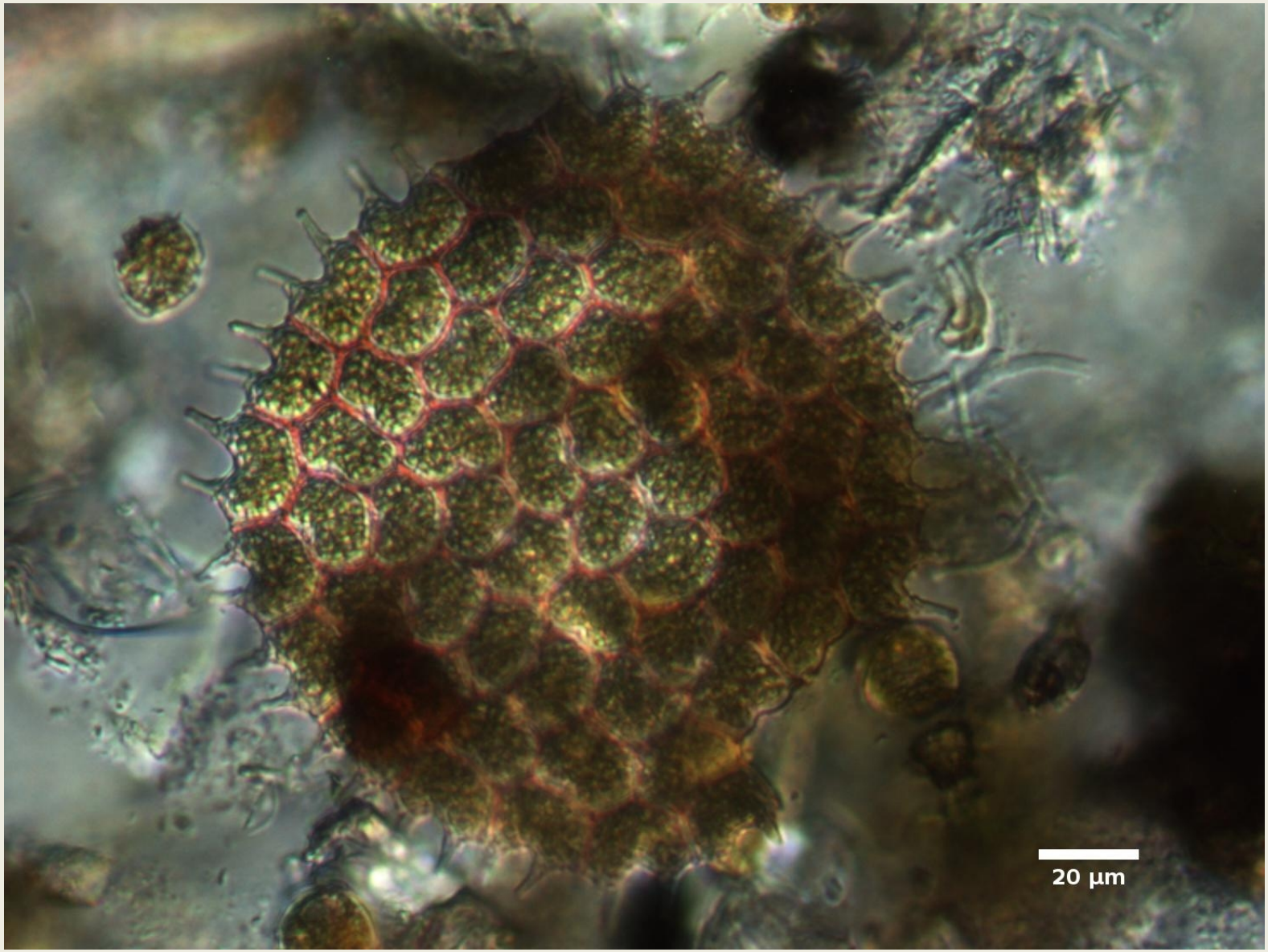



Diversity!
20 µm



Four species of *Micrasterias* (desmid) from >24 species in local mountain lakes

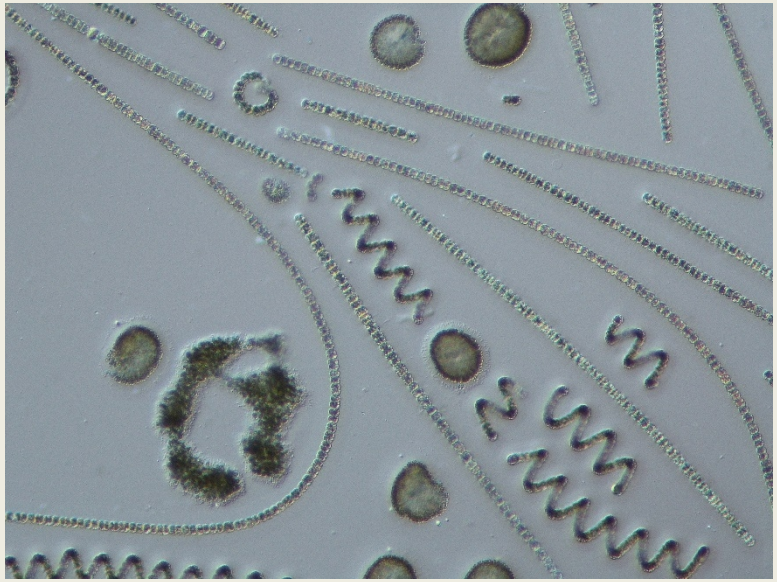

Unusual water quality = unusual algae
Coal Lake
(mining region)
09.15.2010 12:24



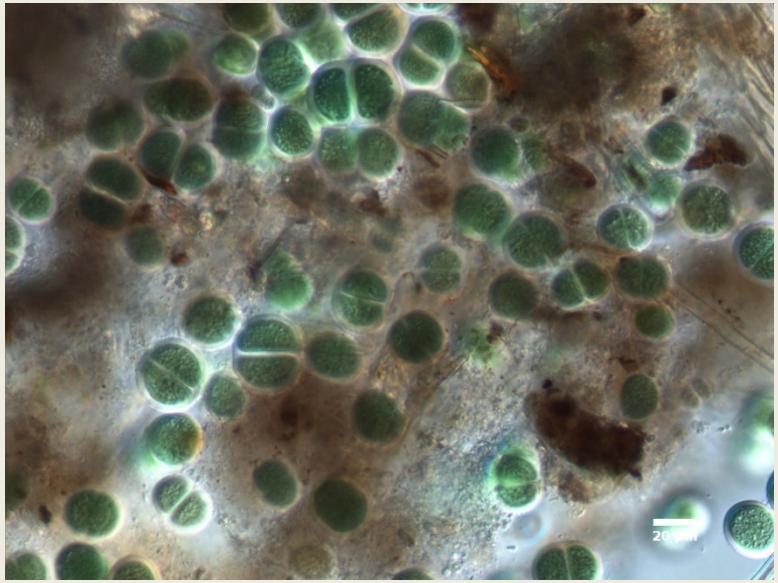
Pediastrum (colonial green from Coal Lake) with pink deposits (manganese?)

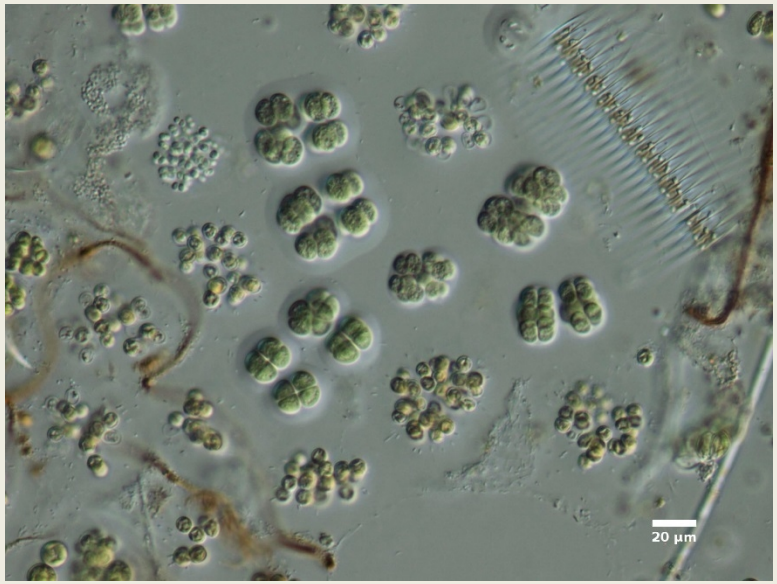

Mountain and low elevation lakes and streams often contain completely
different types of algae, even if they have similar trophic status

Typical low elevation Cyanobacteria bloom

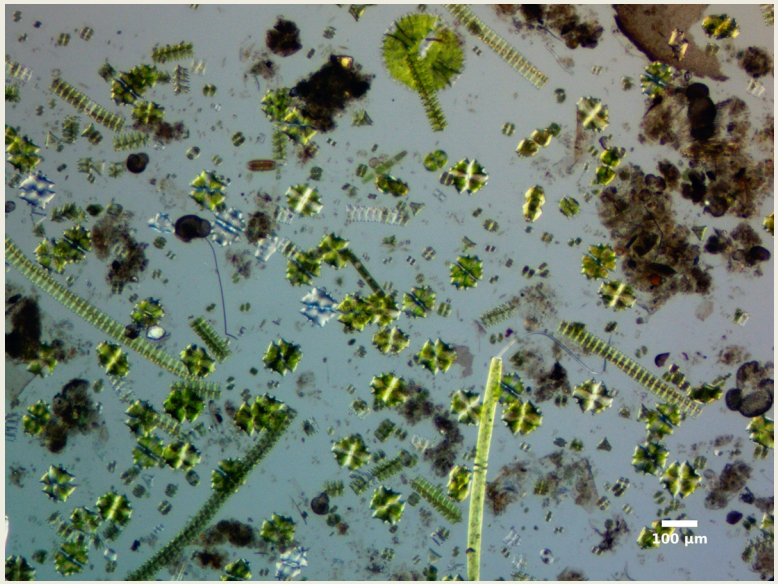


Typical high elevation Cyanobacteria bloom





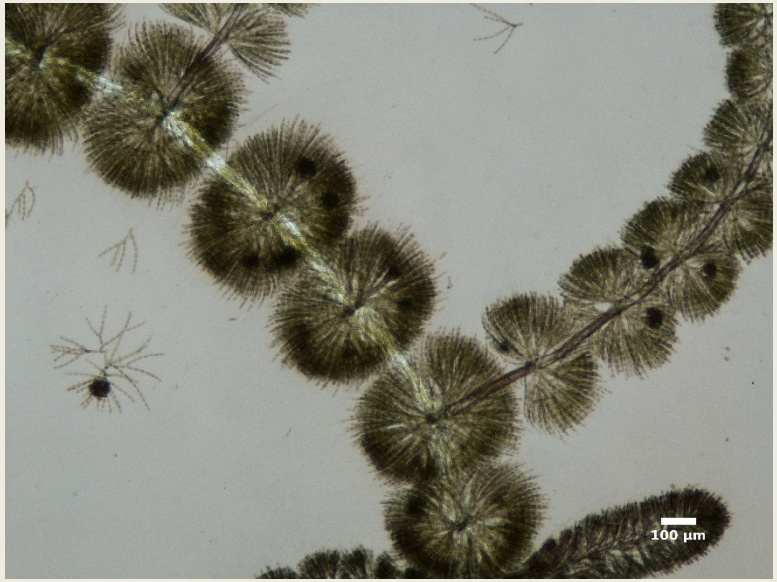
Typical low elevation mixed algae bloom



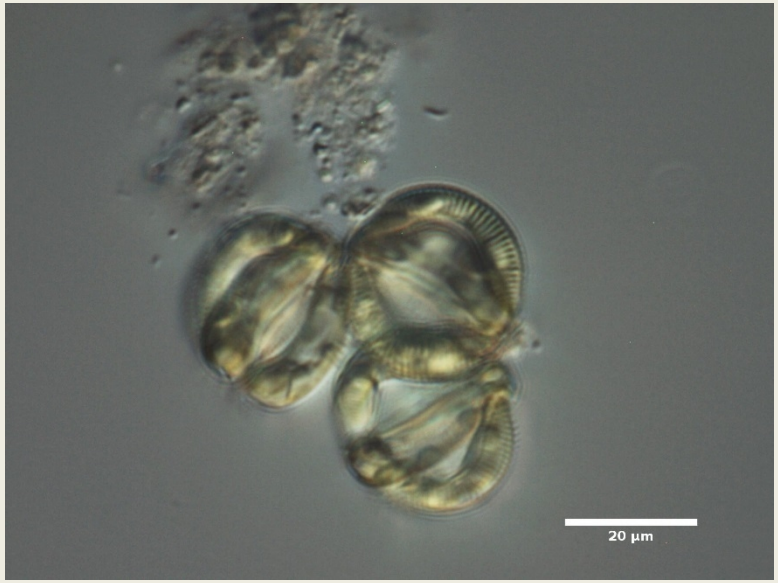
Typical high elevation mixed algae bloom

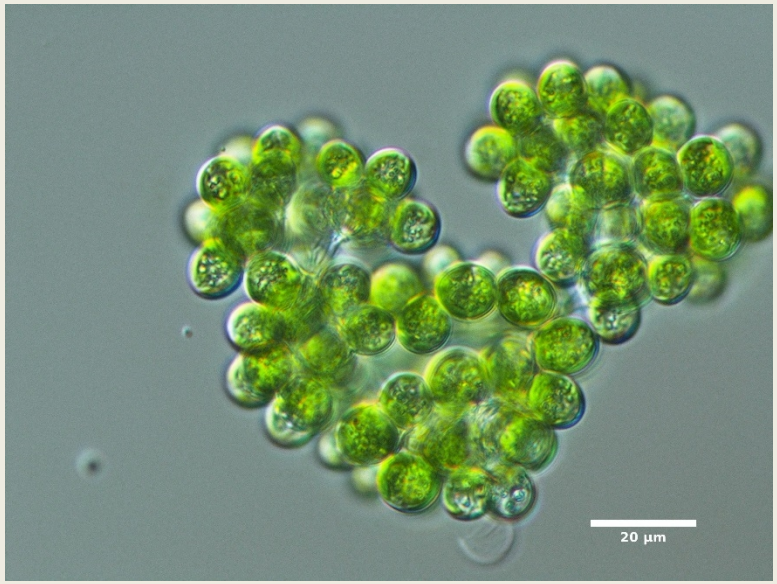

Collecting Methods
20 µm

Red algae – attached to rocks in streams

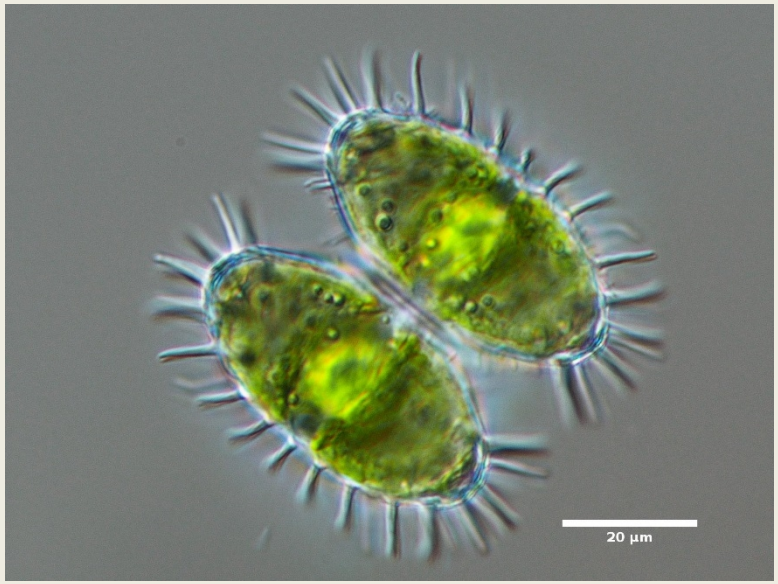


Diatoms – usually on sediment and vegetation





Green algae – often planktonic, but everywhere!



Desmids – pretty much everywhere!


Plankton Nets
Step 1: Detangle


Plankton Nets
Toss/Drag/Repeat






Check contents of net (should look slightly turbid)
Keep cool and out of direct sun (or preserve)


Plankton nets not effective here, but algae still present in damp mud and wet vegetation


Scrap rocks and collect submerged vegetation in flowing water




Lots of
attached algae


Boardwalks and other raised surfaces provide excellent access


Rocks (and rock ledges)
are also good access points
Nice green algae
attached to end of
rock – accessible by
underwater ledge


Sometimes, the access is just not safe!


Sample Processing
20 µm

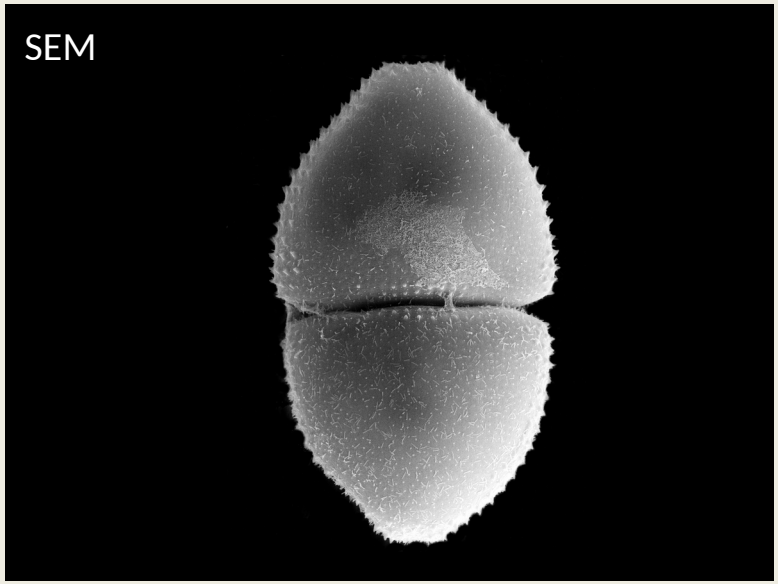


Live or Preserved Samples?

- If algae can't be examined within 24-48 hours, they need to be preserved
- Samples can be preserved with Lugol's iodine solution or 3-4% buffered formalin
- Lugol's turns cells orange or brown; turns starch dark brown or black
- Glutaraldehyde preservation is often used to examine algae using SEM

Cosmarium ovale DIC (live), preserved, and SEM images

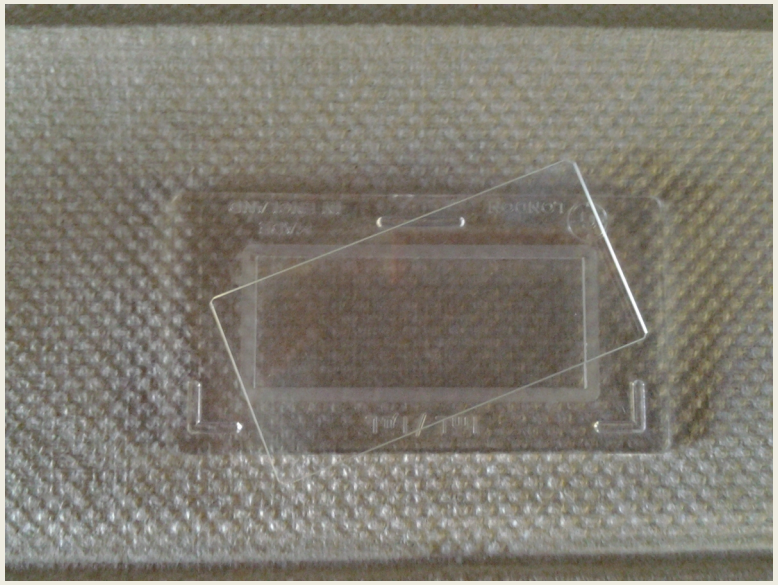




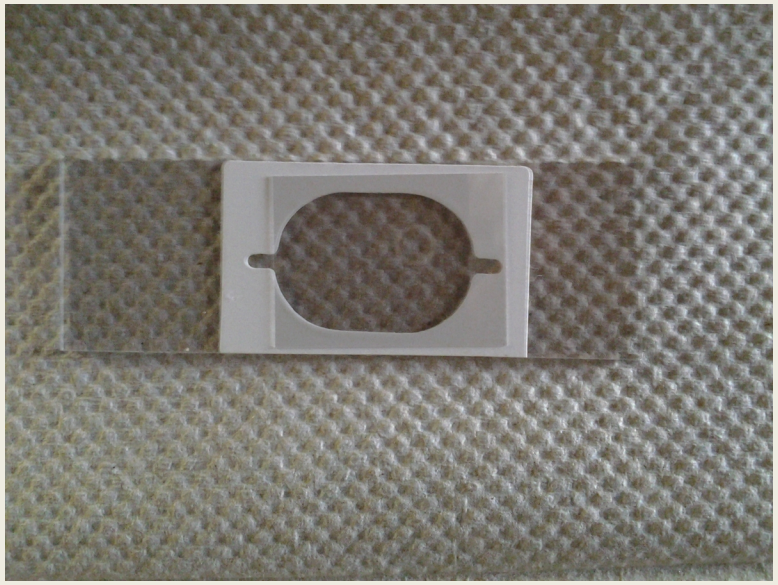


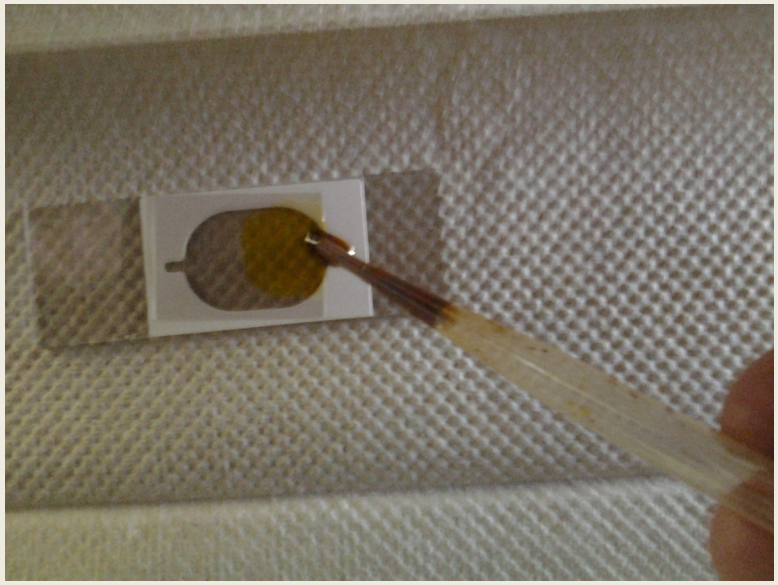


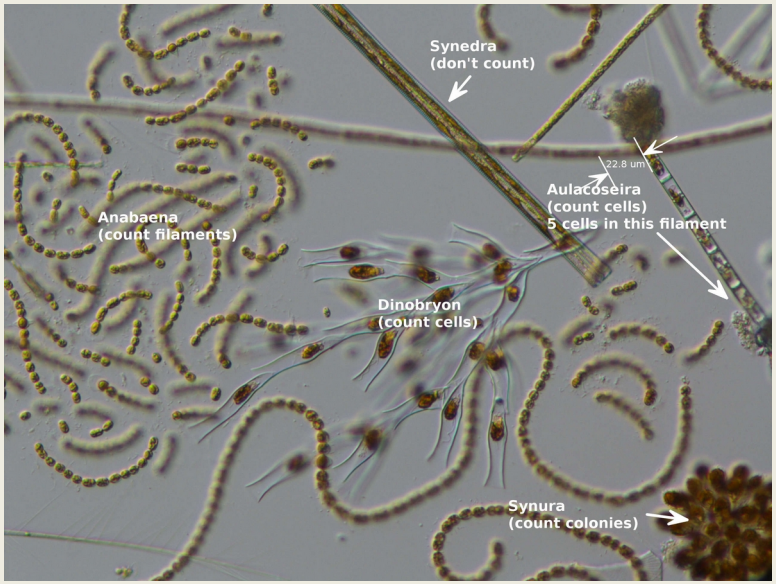

Examples of settling unconcentrated samples that were preserved using Lugol's to measure algal density

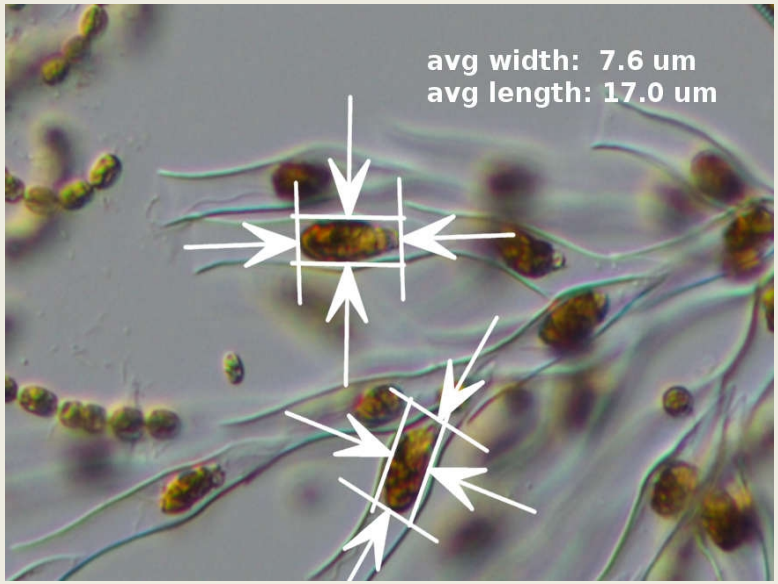












Dinobryon biovolume (rotational ellipsoid)

$$= \quad 4/3 \times \pi \times \frac{\text{length}}{2} \times \left(\frac{\text{width}}{2}\right)^2$$

$$= \quad 4/3 \times \pi \times 8.5 \times 3.8^2 \qquad = 514\ \mu m^3$$

Sites	width µm	length µm	BV µm^3
LW	7.5	17.1	504
LW	8.9	27.7	1149
LW	6.6	20.1	458
LOU	6.3	26.0	540
LOU	6.9	23.1	576
LOU	6.5	19.9	440
SQI	7.2	27.5	746
SQI	6.2	16.7	336
SQI	8.4	22.1	816
TOA	7.2	26.2	711
TOA	7.6	27.0	817
TOA	8.1	28.2	969

min	336 µm^3
mean	672 µm^3
med	644 µm^3
max	1149 µm^3



All algal photographs were taken by R. Matthews