Algal Blooms:

NH Perspective, Macro and Micro Views

Algal Ecology

Key factors affecting bloom development

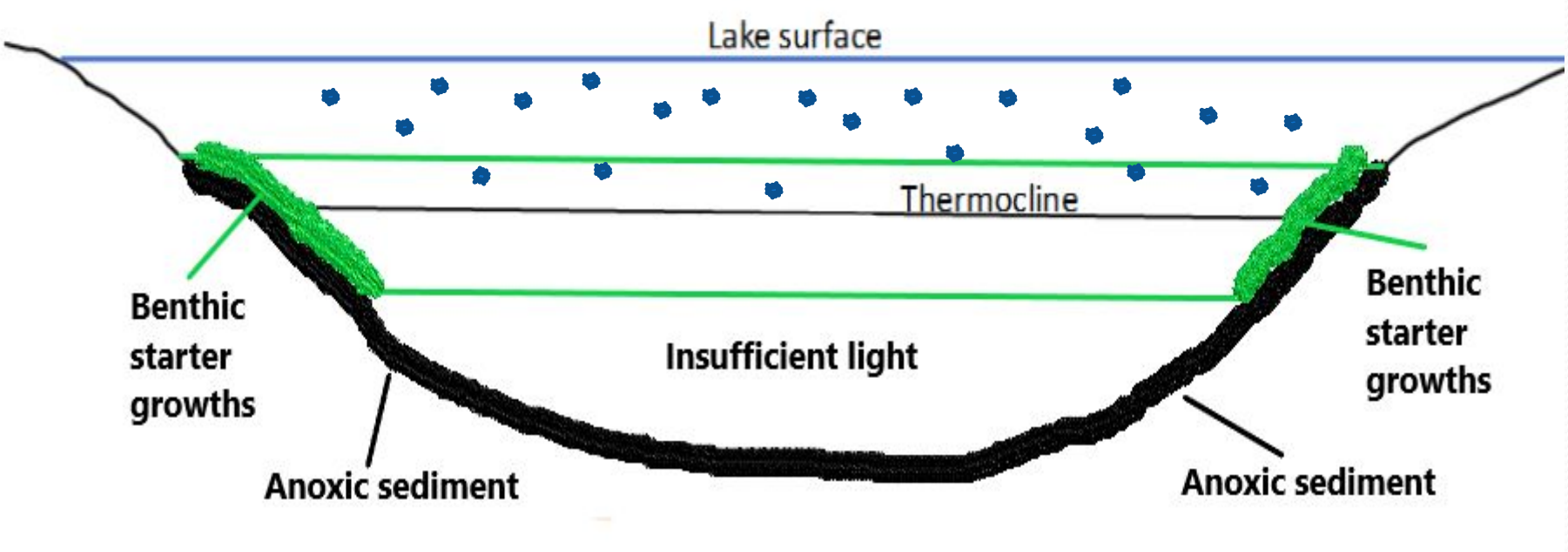
- **Nutrients – availability, ratios relative to algal needs**
- **Light – quantity and quality**
- **Temperature – different algae have different optima**
- **Wind, mixing and flushing – hydrologic influences**
- **Heterotrophy – not all algae depend solely on photosynthesis**

Everything about climate change favors cyanobacteria over other algae: warmer temperatures, stable water column, faster and more extensive loss of oxygen at sediment-water interface, greater release of P at low N to P ratio.

Algal Ecology

Bloom formation modes

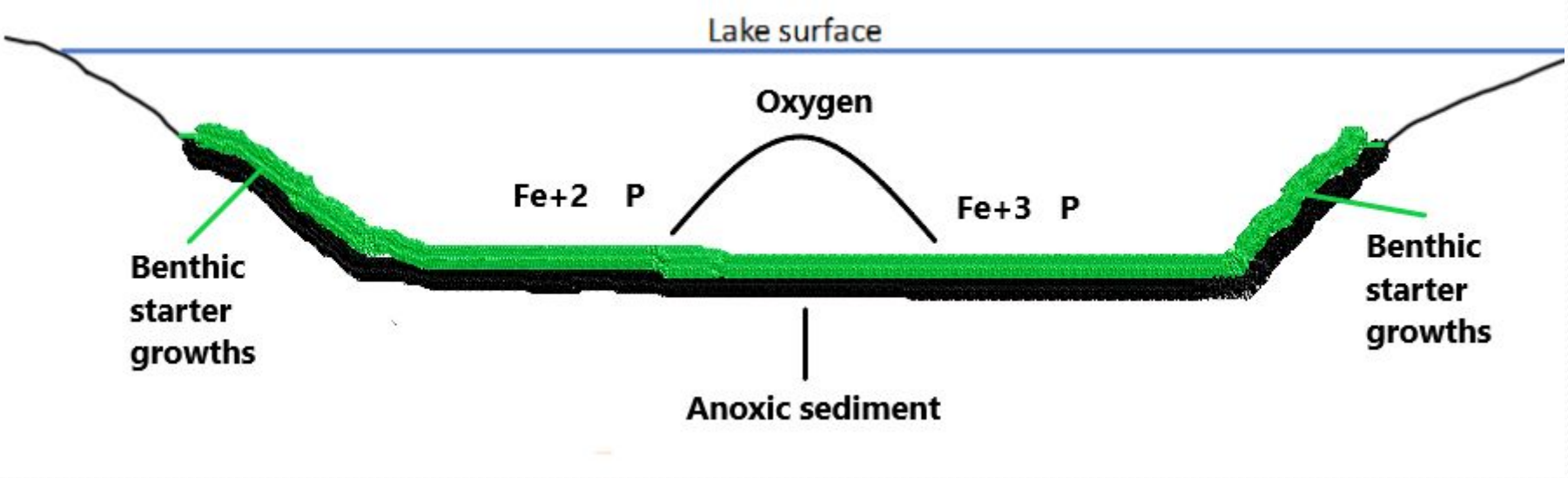
- **Growth in the upper water column – any algae if nutrients sufficient, takes weeks for bloom to form**
- **Growth near thermocline – enough light from above, nutrients from below, algae layer forms, can come to surface**
- **Growth near sediment-water interface – germination of resting stage, growth to mature cells with luxury nutrient uptake, potential to rise in water column**



Algal Ecology

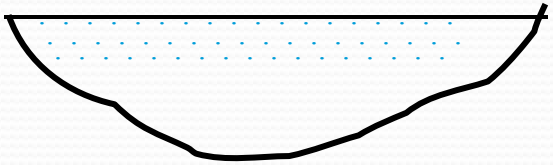
Shallow lakes may have a bigger problem

- **Light penetrates to most if not all of the bottom**
- **Most of the lake bottom can be a P source and substrate for benthic growths in shallow lakes**
- **Benthic starter growths for planktonic forms can flourish**



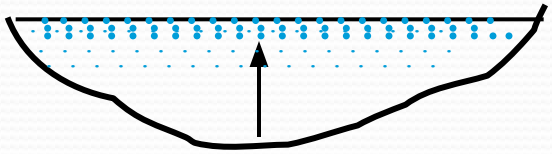
Algal Accumulation Phenomenon

initial distribution



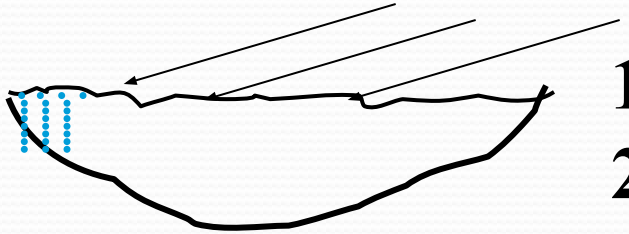
10,000 cells/L;
<2 µg/L toxin

buoyancy



100,000 cells/L;
5-20 µg/L toxin

wind

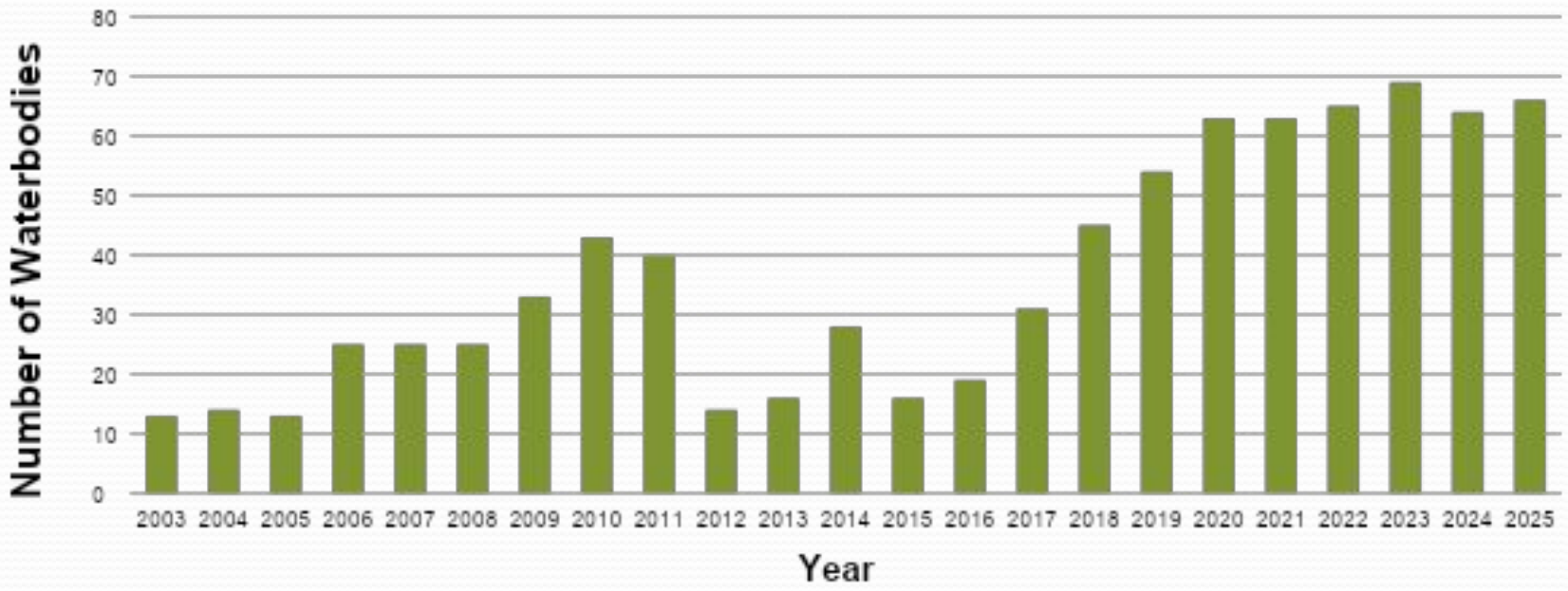


1,000,000 cells/L;
200 µg/L toxin

From NLA and papers in LRM from 2012:

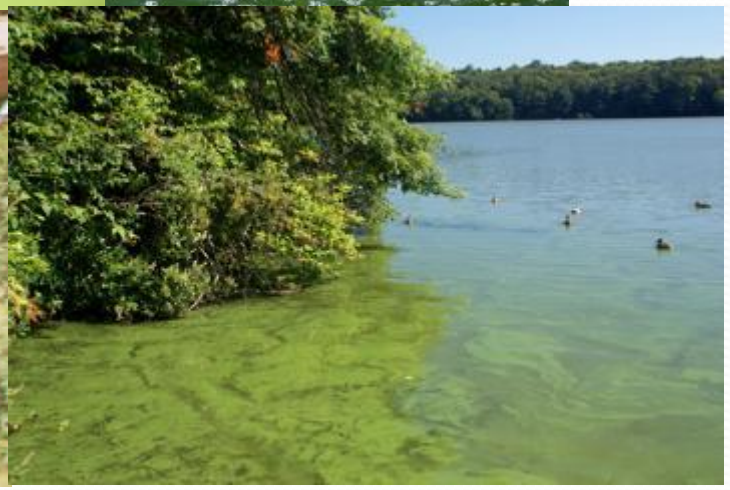
- Toxins at hazardous level in random lake samples = 1%
- Toxins at hazardous level in samples from known blooms – 20%
- Highest potential for toxicity – shoreline accumulations due to both higher density and poor physiological condition of cells

Waterbodies with Reported Cyanobacterial Blooms in New Hampshire



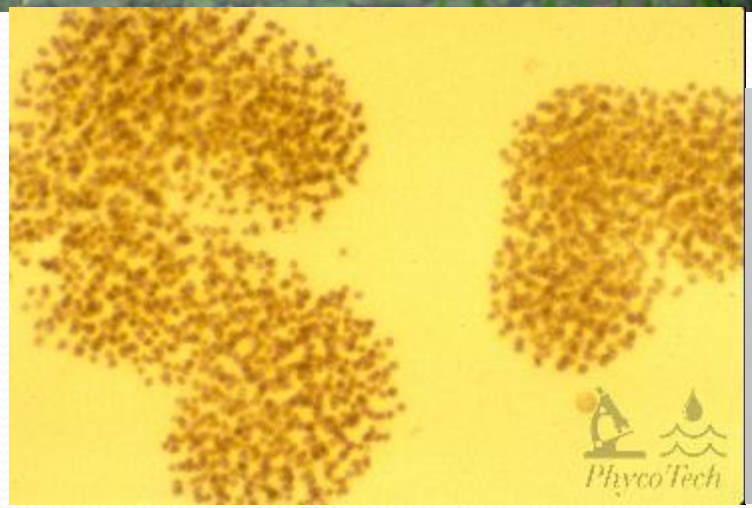
Are there more blooms, or are we just noticing more? The short answer is "Yes"!

Algal Blooms: Cyanobacteria



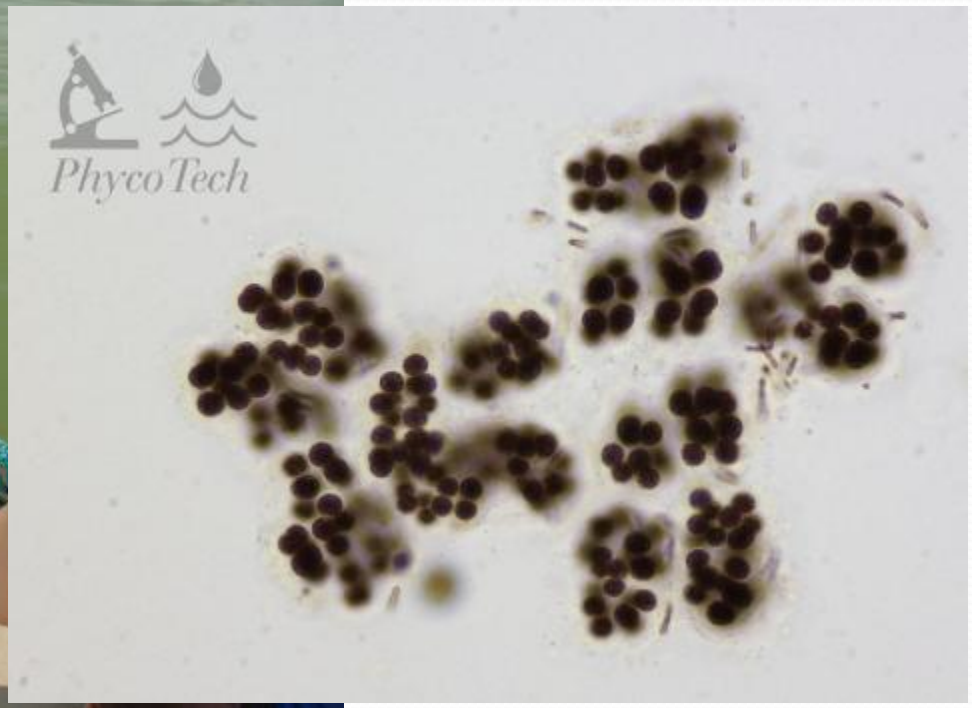
Blue-green Algae

Microcystis aeruginosa



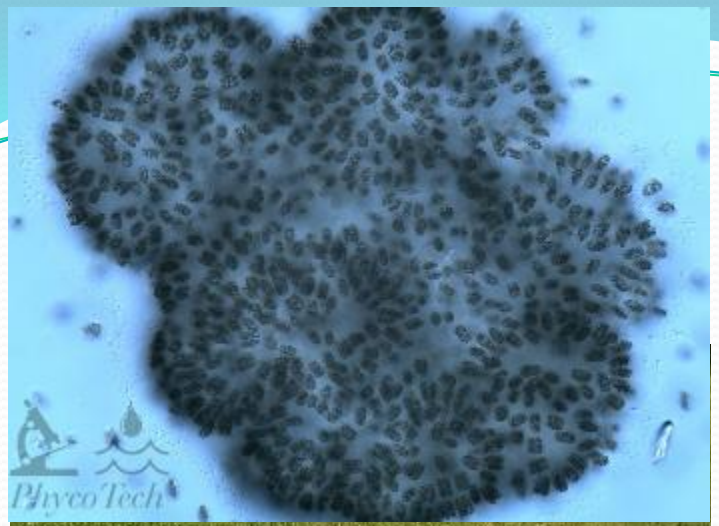
Blue-green Algae

Microcystis viridis



Blue-green Algae

Dead *Microcystis*



Blue-green Algae

Woronichinia naegeliana

Blue-green Algae

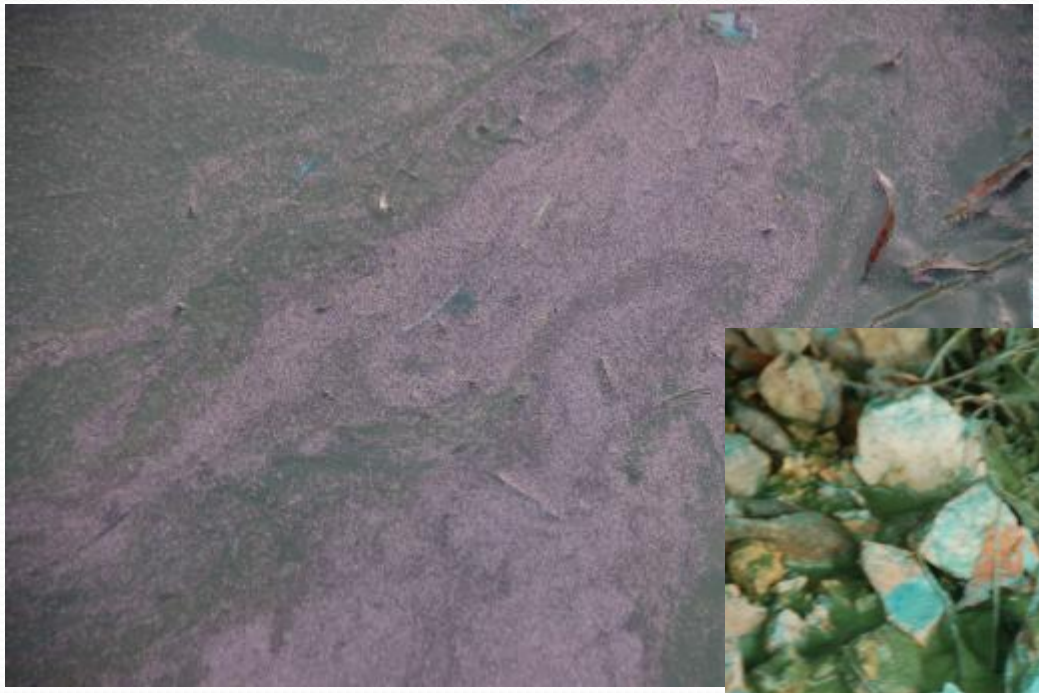
Dolichospermum (Anabaena) lemmermannii

Blue-green Algae

Dolichospermum (Anabaena) mendotae

Blue-green Algae

Dead *Dolichospermum (Anabaena)*



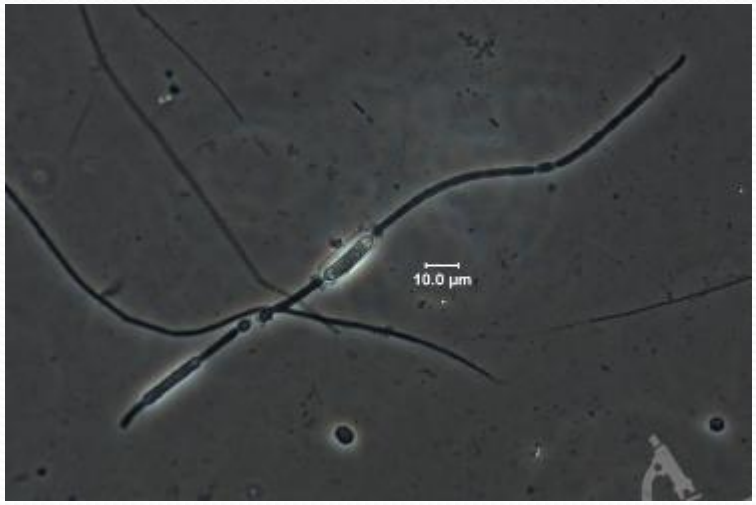
Blue-green Algae

Aphanizomenon flos-aquae

"Grass Flake" morphology

Blue-green Algae

Aphanizomenon gracile

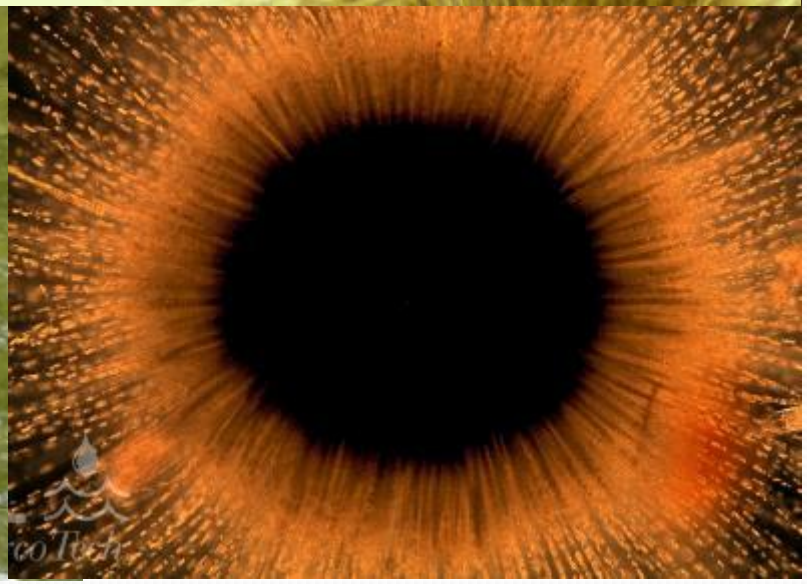


Photos courtesy of Lyn Crighton

Blue-green Algae

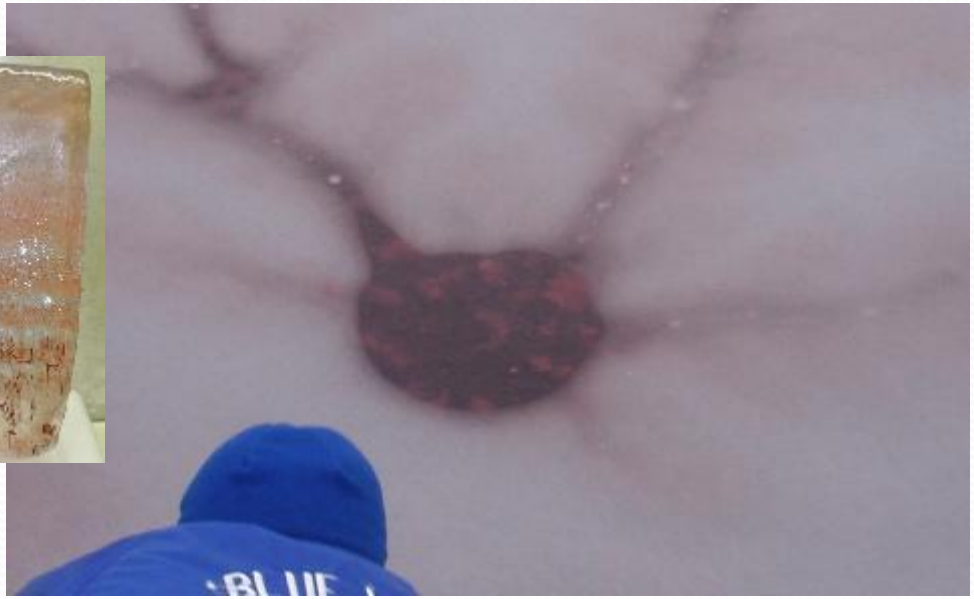
Gloeotrichia echinulata

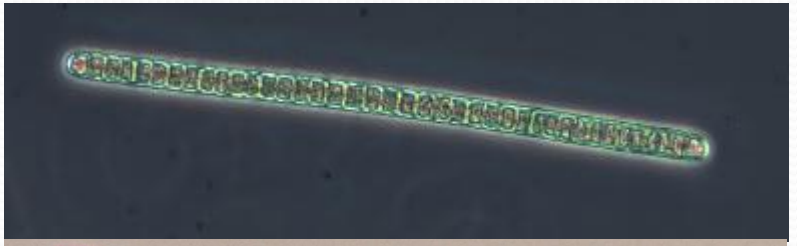
Photo: Midge Eliassen, New Hampshire

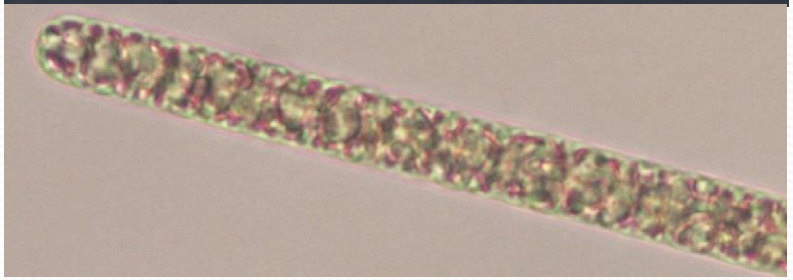


Blue-green Algae

Planktothrix

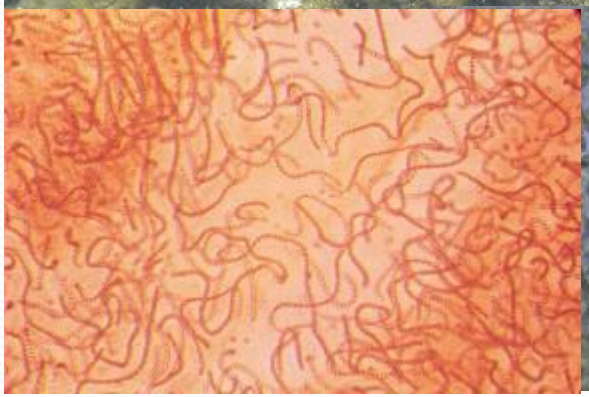


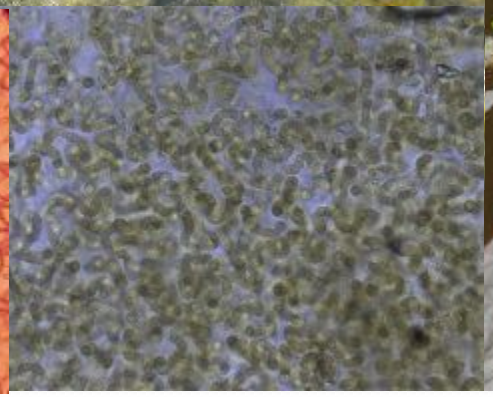




Blue-green Algae

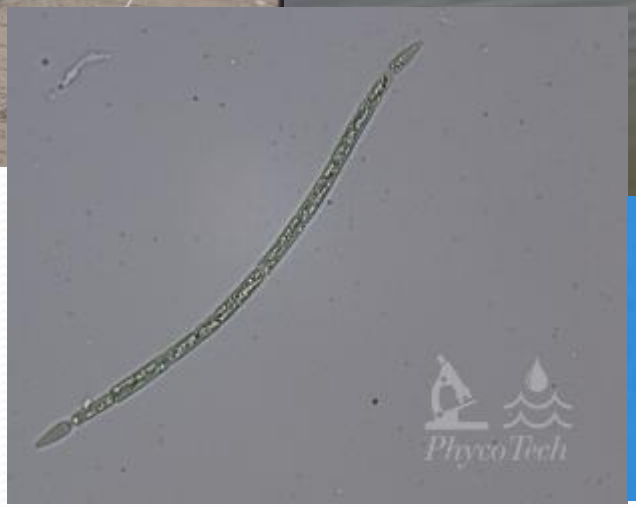
Nostoc





Blue-Green Algae

Raphidiopsis (*Cylindrospermopsis) raciborskii*

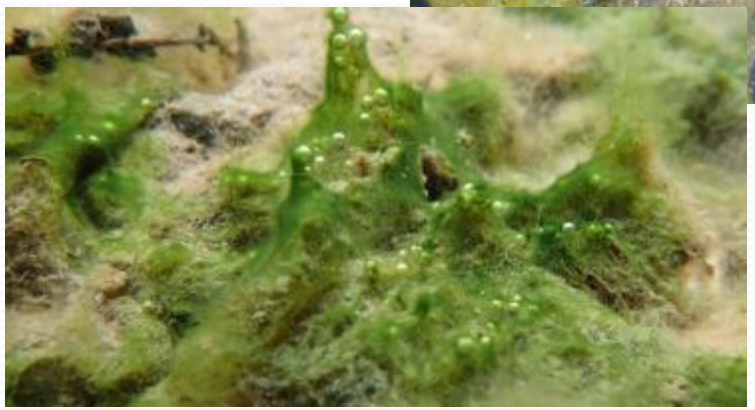


Blue-green Algae

Nodularia spumigena

Photo provided by
Wayne Wurtsbaugh

And if water column threats are not enough to worry you, there are periphytic cyanobacteria; something else to look out for!

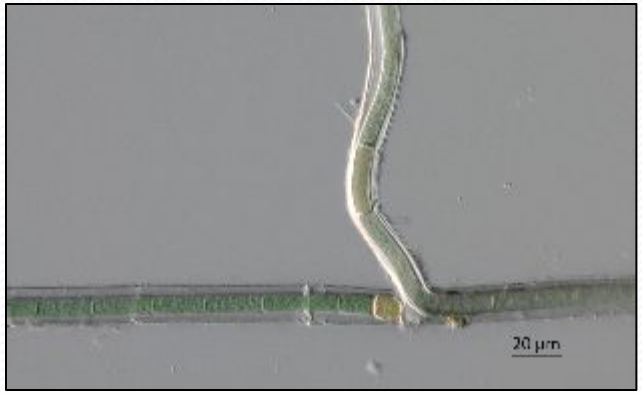


Blue-green Algae

Oscillatoria

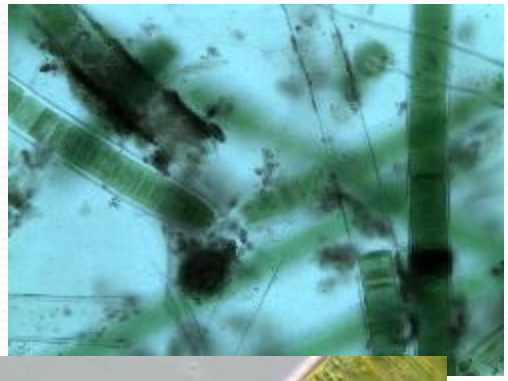
Blue-green Algae

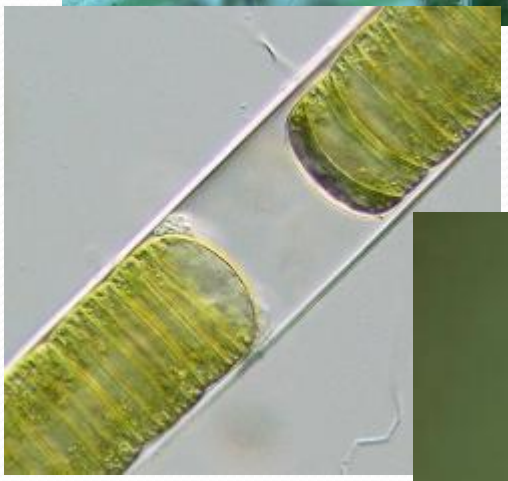
Tolypothrix



Blue-green Algae

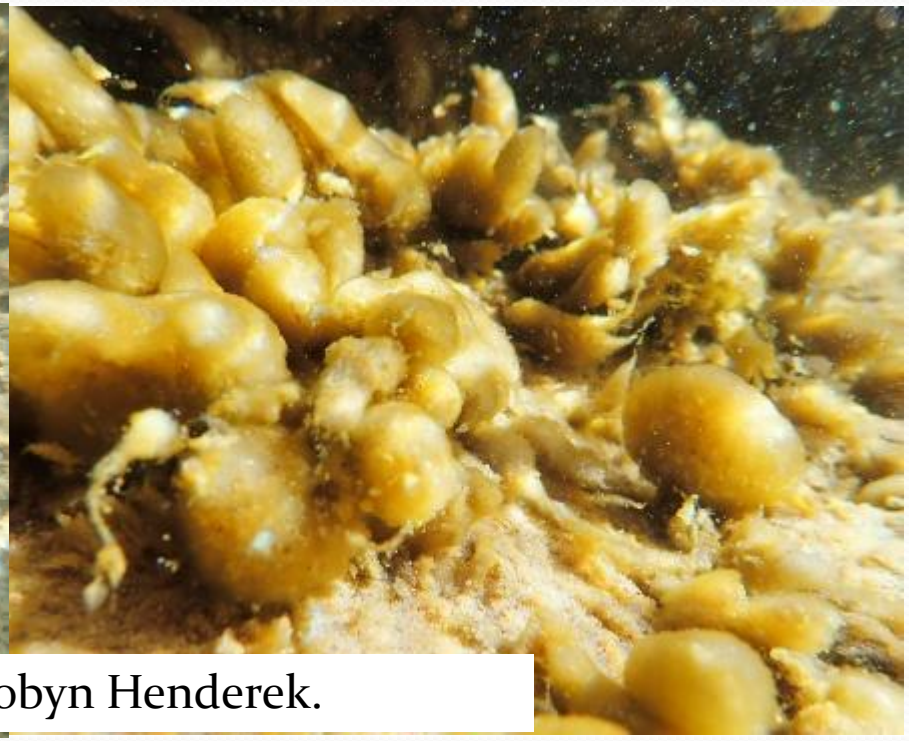
Microseira (Pectonema, Lyngbya)





Blue-green Algae

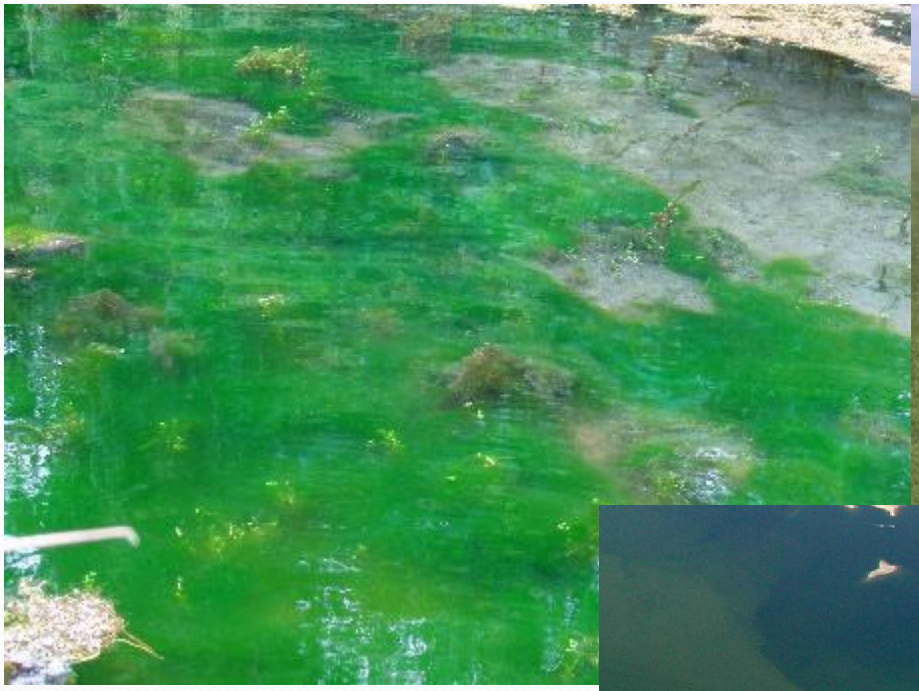
Microcoleus/Tychonema

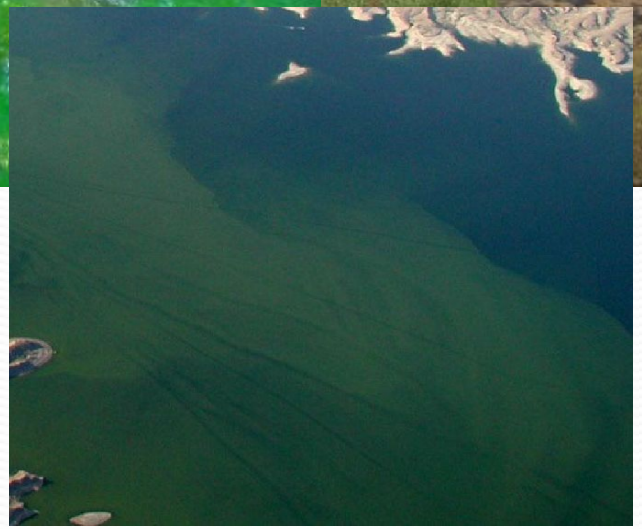


Photos: Robyn Henderek.

Photos: Barry Rosen

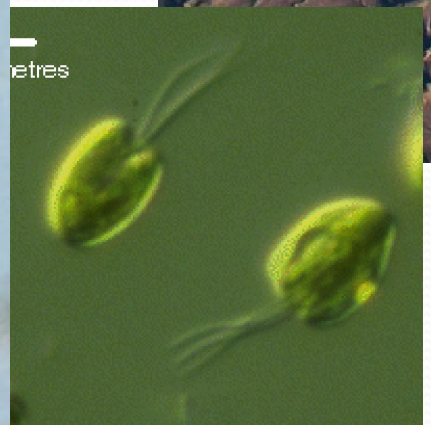
Algal Blooms: Chlorophyta





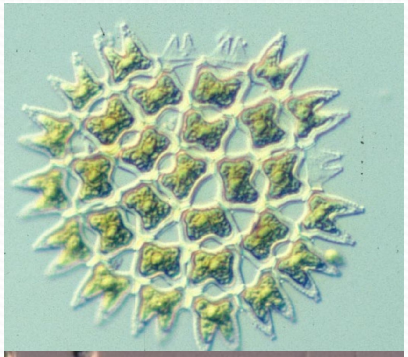
Green Algae

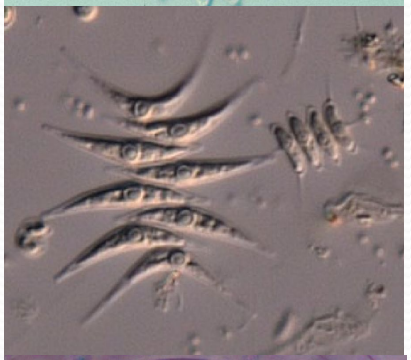
Volvocales (flagellated greens)

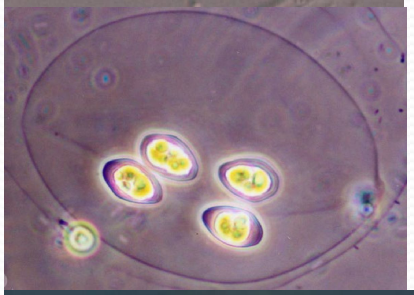


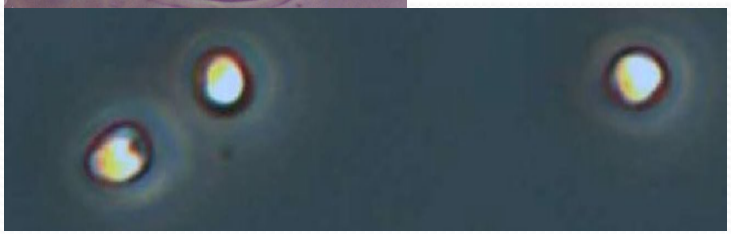
Green Algae

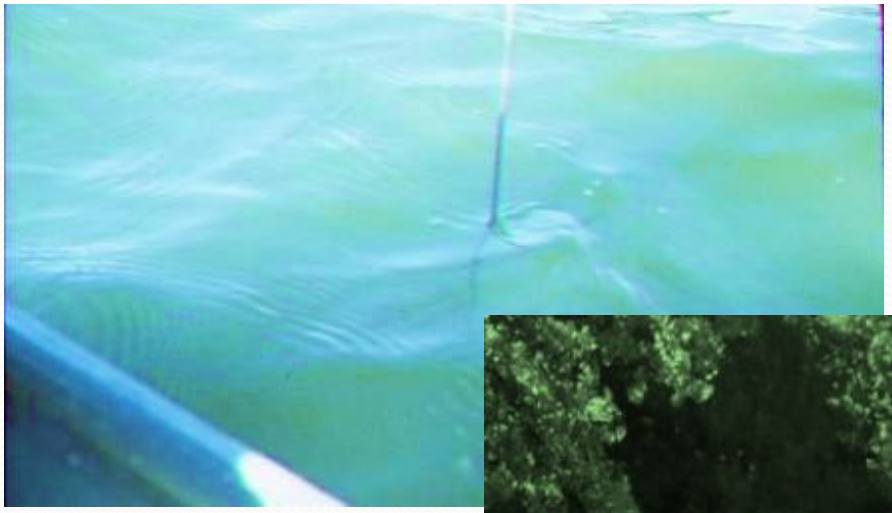
Chlorellales/Sphaeropleales











Green Algae

Cladophora

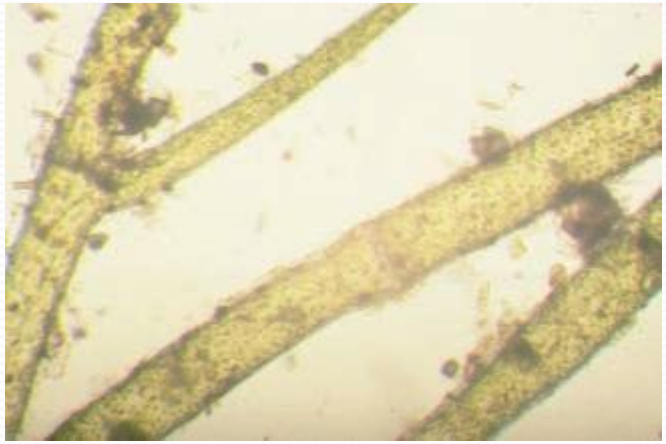


Photo above provided by Jennifer Graham

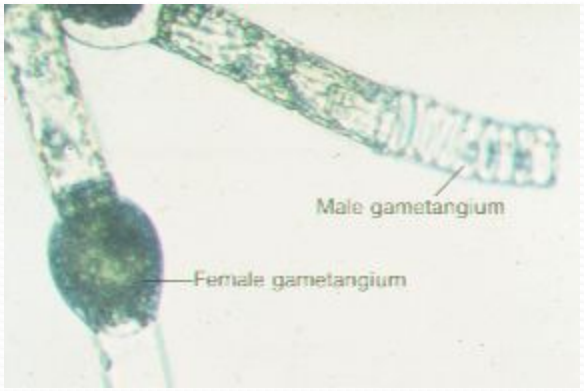
Green Algae

Mougeotia

Photos: Steve Heiskary, MNPCB

Green Algae

Oedogonium

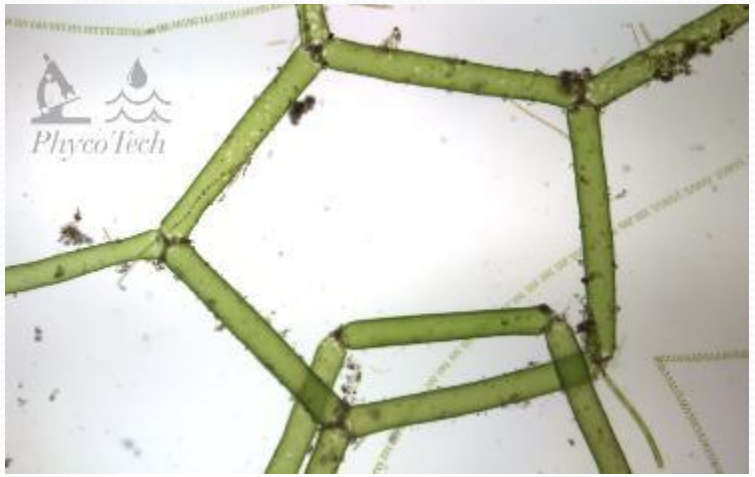


Green Algae

Hydrodictyon

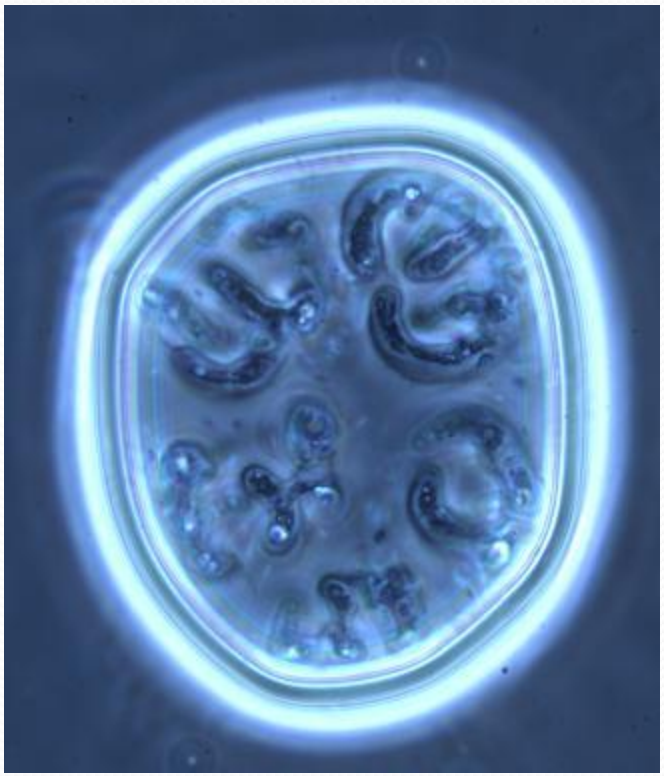
Above Photo:
http://marple.eeb.uconn.edu/gratolwww/?page_id=114

Upper Right Photo: Ken Wagner



Green Algae

Helicodictyon planctonicum



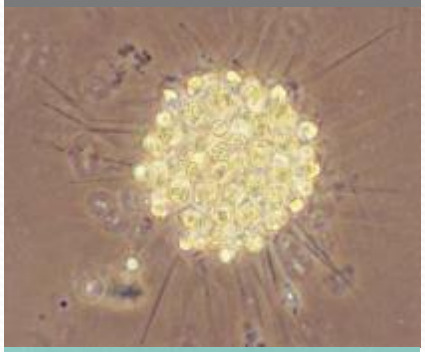
Green and Blue-green Algae (can co-occur)

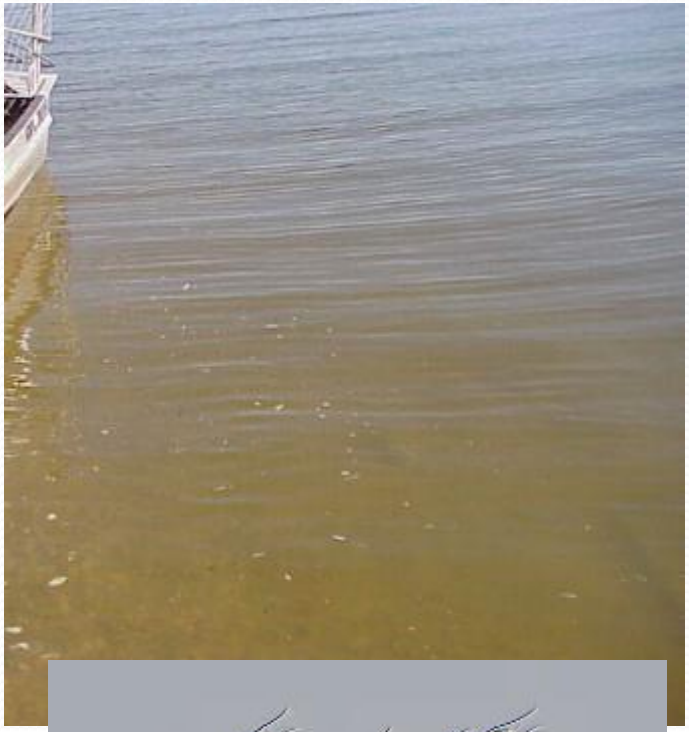
Algal Blooms: Other Algae

- Chrysophyta - golden algae
- Pyrrhophyta – dinoflagellates
- Bacillariophyta – diatoms
- Euglenophyta - euglenoids

Golden Algae

Synura - Chrysosphaerella - Dinobryon





Dinoflagellate Algae

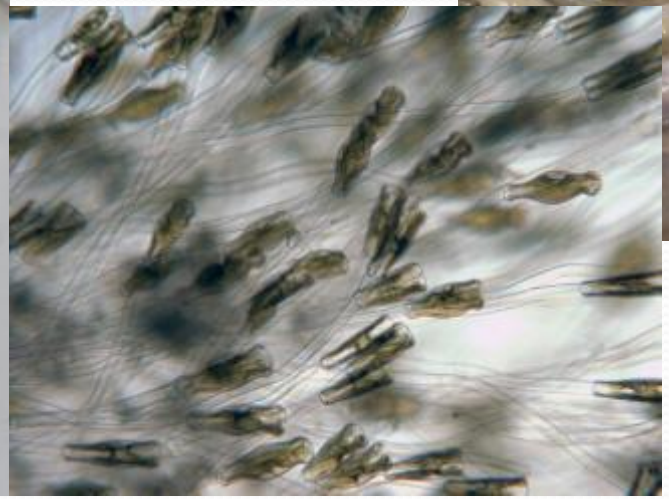
Ceratium

Diatom Algae

Nitzschia/Navicula

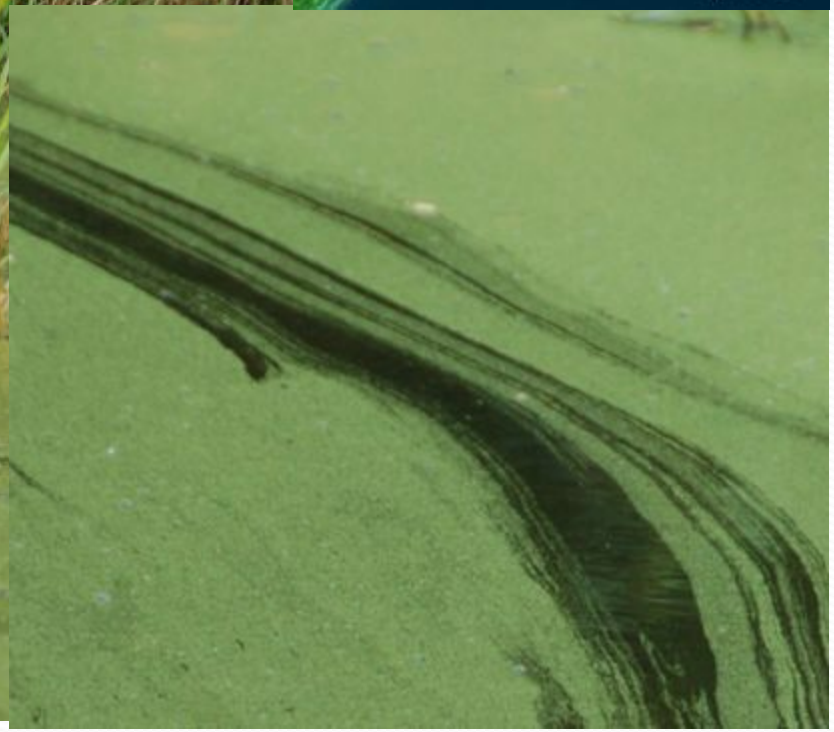
Diatom Algae

Didymosphenia (Rock snot)



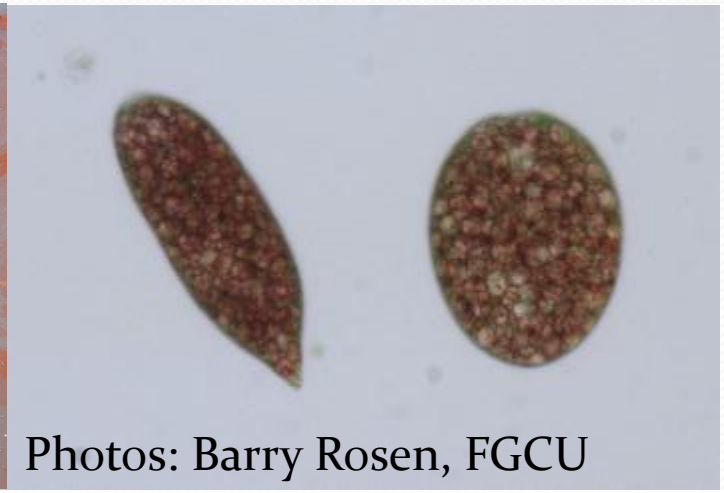
Euglenoid Algae

Euglena



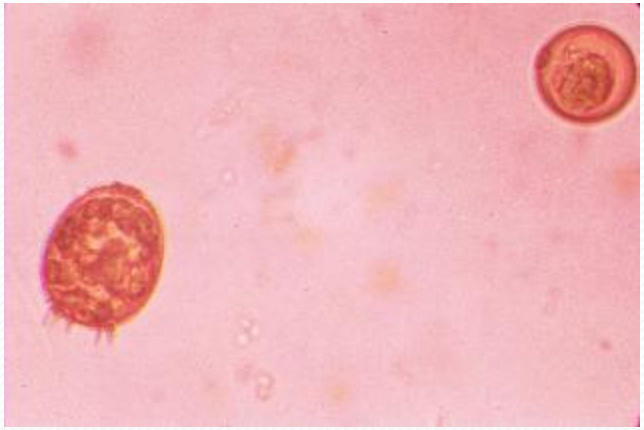
Euglenoid Algae

Euglena sanguinea



Photos: Barry Rosen, FGCU

Trachelomonas



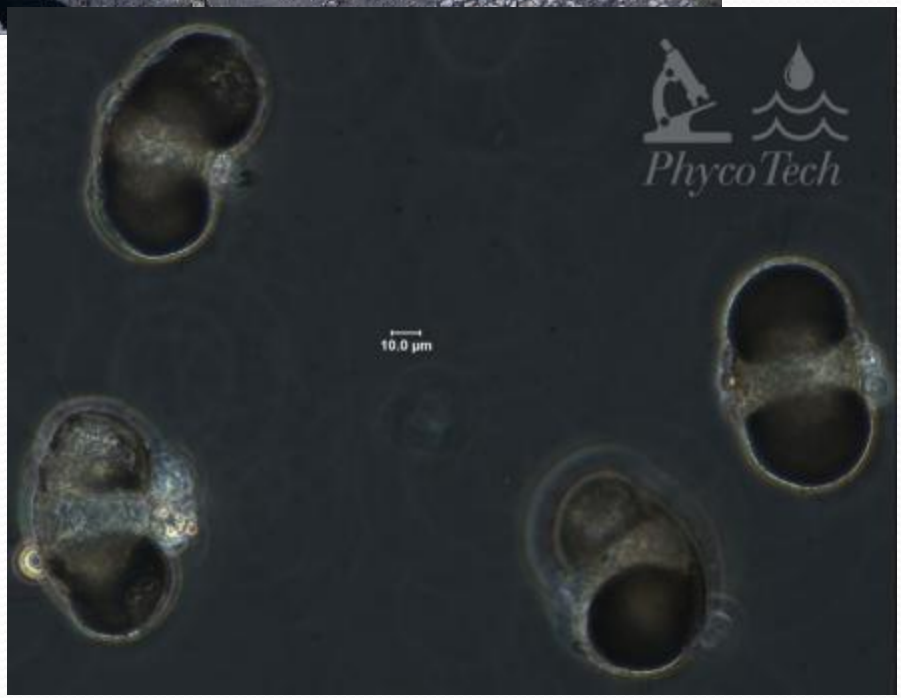
Non-Algae

- Pollen
- Floating plants
- Zooplankton
- Bacterial accumulations

Pollen

Photo provided by Linda Green

Photo provided by Walter Medwid



Duckweed *(Lemna gibba)*

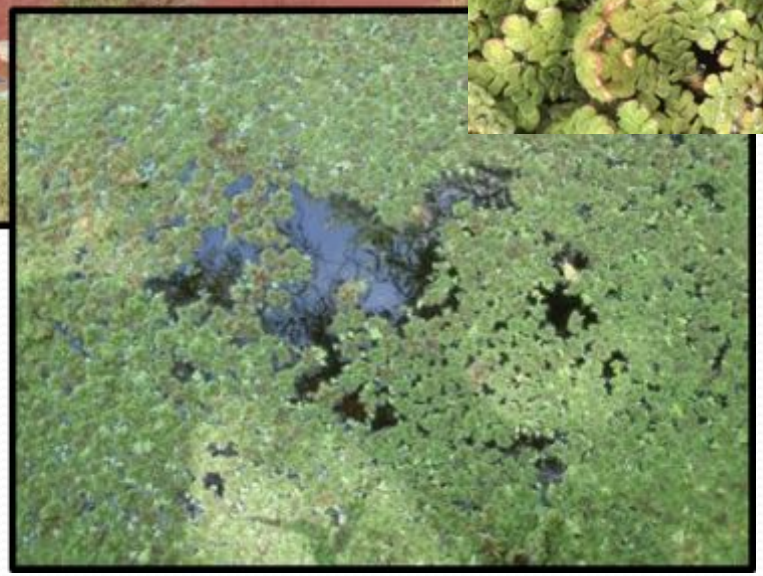
Photo provided by Paul Skawinski

Photos provided by Linda Green

Watermeal *(Wolfia columbiana)*

Inset Photo provided by Linda Green

Water Fern (*Azolla sp.*)



Upper Left Photo: Jennifer Graham

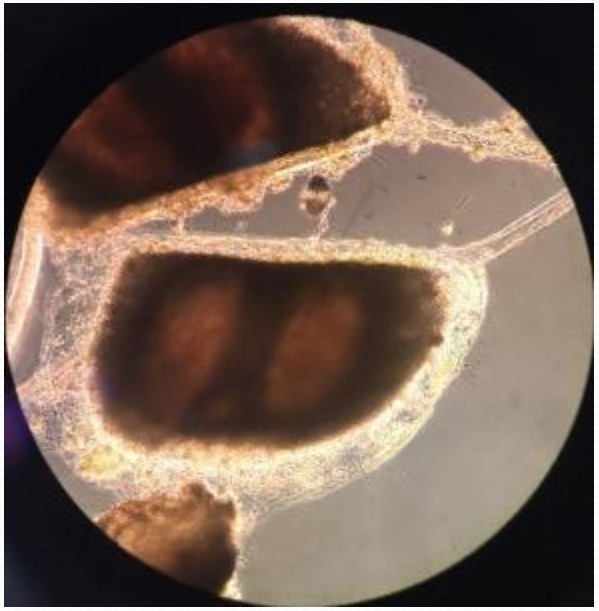
Upper Right and Center Photos: Missouri Department of Conservation

Zooplankton

Daphnia Ephippia

Surface accumulation of zooplankton resting spores, Lake Champlain VT.

Photo: Pete Stangel, VT DEC.

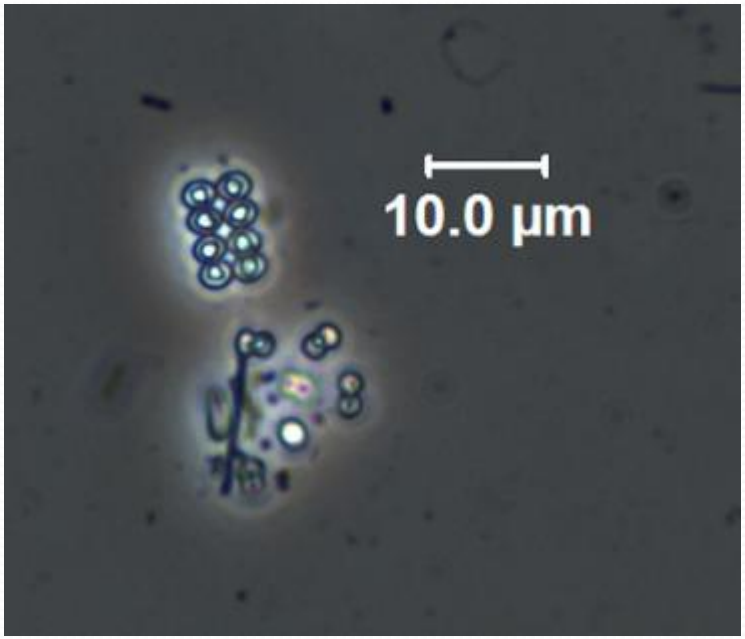


Zooplankton resting spores lack photosynthetic pigments and have a very uniform appearance. A – closer look. B – Appearance under the microscope. Lake Champlain, VT.

Photo: Angela Shambaugh.

Purple Sulfur Bacteria

Thiopedia



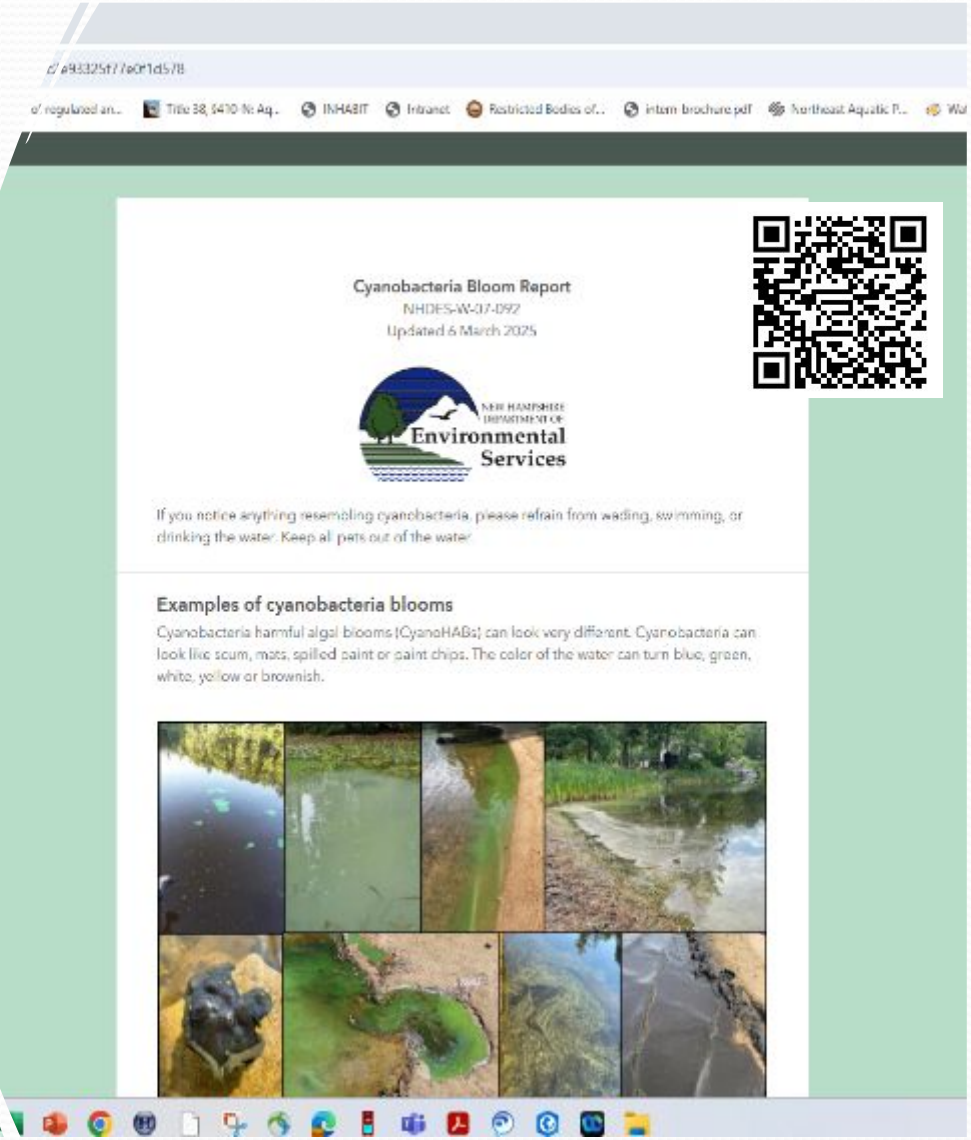
New Signage


BE ON THE LOOKOUT FOR
CYANOBACTERIA BLOOMS
LOOK
Do you see discoloration or unusual growth?
Cyanobacteria can look like clouds, scum, mats, streaks or clumps along the shore or in the water.
Current cyanobacteria warnings and watches are updated online on the NHDES Healthy Swimming Mapper.
Go online to see current conditions.
CHECK
REPORT
See a potential bloom? Report it.
Do not wade, swim or let pets in the water near the suspected bloom. Always wash with clean water after any contact.
Check conditions before:
Swimming
Fishing
Boating
Pets
Environmental Services
Cyanobacteria HAB Program | HAB@des.nh.gov | (603) 848-8094

New Hampshire Bloom Report Form

If you suspect a bloom:

1. Take photos
2. Note distribution (lakewide, shoreline, isolated, etc)
3. Safely collect a sample
   - Look for area of higher density bloom material
   - Wear gloves if you have them and wash hands after sampling
   - Use any clean bottle/jar
   - Seal in a Ziploc bag and include sample location, date, your name and email
4. Submit a bloom report form
5. Drop a sample off at NHDES for microscopic ID



Cyanobacteria Self Risk Assessment

- Two new video recordings available that discuss risk associated with HABs, and how to mitigate your personal risk:
  - **Full version (6:37 minutes):** https://www.youtube.com/watch?v=RJmY5BIt_q8&list=PLzaaFQKgZ-Fio CCxV22Mul9cG3H7qgFnG&index=1&pp=iAQB
  - **Short version (2:57 minutes):** https://www.youtube.com/watch?v=7CkS2GONaaI&list=PLzaaFQKgZ-Fio CCxV22Mul9cG3H7qgFnG&index=2&pp=iAQB

The End

QUESTIONS?