

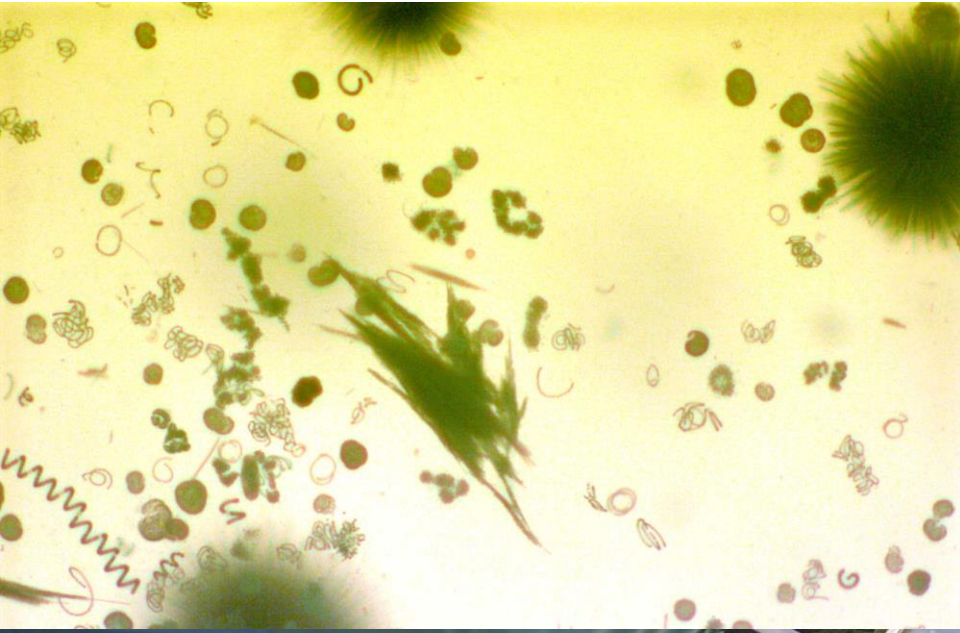
# Algae 101: An Introduction to Harmful Algal Blooms

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# What are blue-green algae?

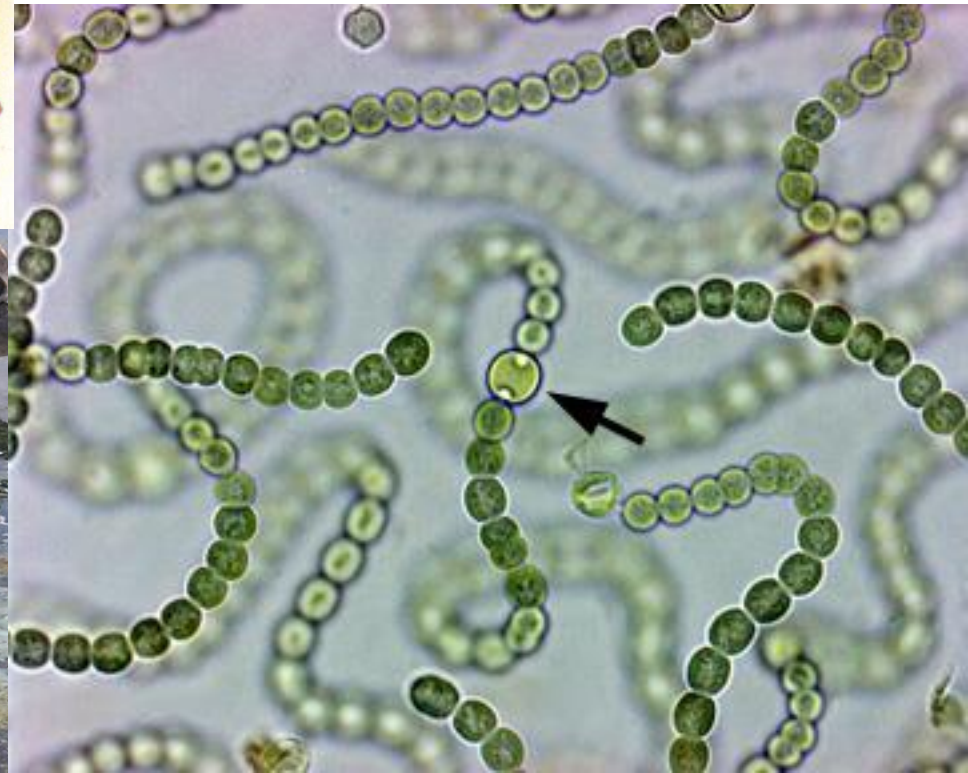


Specialized plant-like bacterium  
called Cyanobacteria

8000 species

3 billion years of evolution

not all are bad....







Blooms often  
concentrate at  
the shoreline or  
along docks.

**Not every bloom or every scum is cyanobacteria. .**



**Green (and Slimy)  
Algae**



*Spirogyra* and  
*Mougeotia*



Pretty easy to tell under a microscope...



*Anabaena*



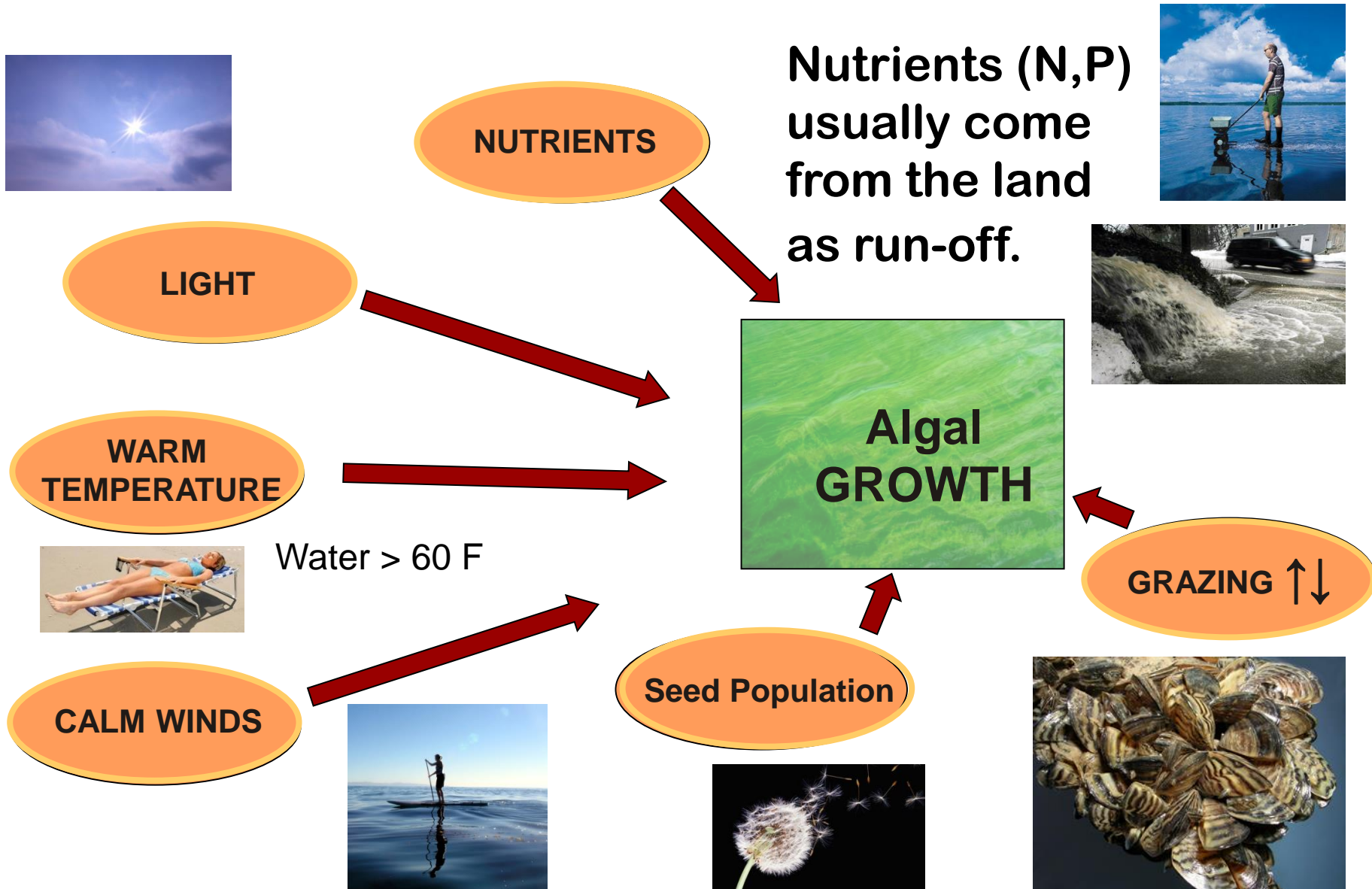
*Aphanizomenon*



*Microcystis*

*Known to a generation of scientists as Anni, Fanni and Mike  
(3 most common bloom-forming species)  
NOT the three most common toxic species!*

# Why do the algae grow?



# How do we prevent blooms?

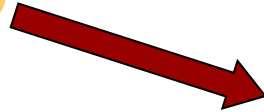
- We know the seed population is there
- Zebra mussels may promote blooms or “harvest blooms”, best bet is to keep them out of the system.



# How do we prevent blooms?



**LIGHT**

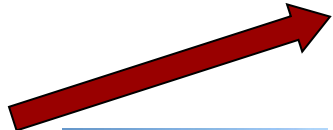


**WARM  
TEMPERATURE**



Water > 60 F

**CALM WINDS**



Not much we can do about light, temperature and winds



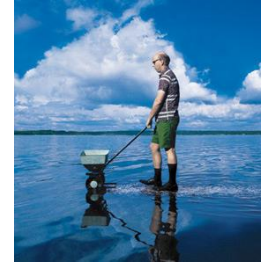
If anything – climate changes predicts we will have more calm days and warm falls (aka a longer growing season)



# How do we prevent blooms?

NUTRIENTS

Nutrients (N,P)  
usually come  
from the land  
as run-off.



That brings us to  
nutrients.....

It is not the only thing  
important, it is the only  
thing we can control.

Algal  
GROWTH



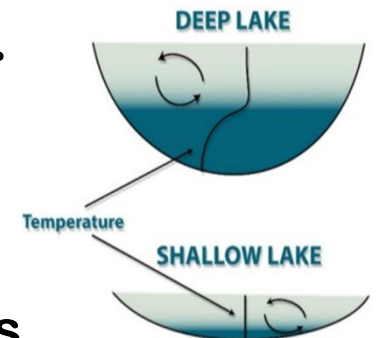
Blue-green algae don't care what is the source of nutrients.  
*control both episodic and continual inputs*

# Why are they called Harmful?



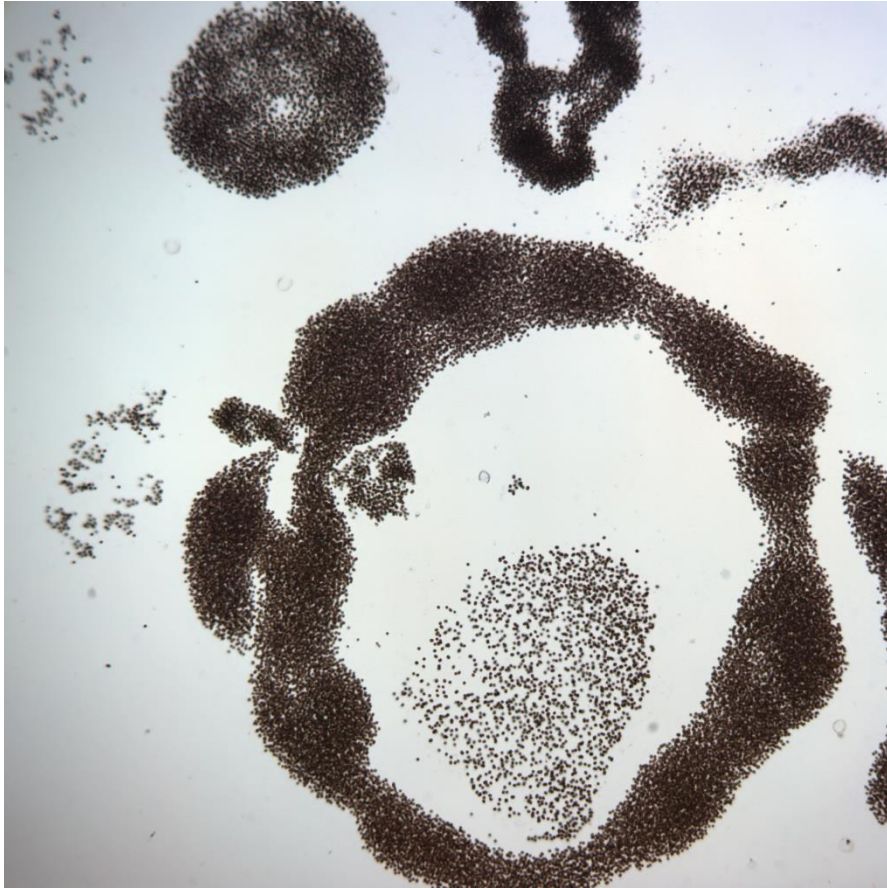
- Cyanobacteria are a common member of the aquatic flora!
- Some (not all) produce:
  - liver toxins (hepatotoxin).
  - Neurotoxins
  - Other nasty compounds
    - Swimmers itch
    - Alzheimer's-like agents.
- When they die – it uses up oxygen.

Especially important in stratified lakes





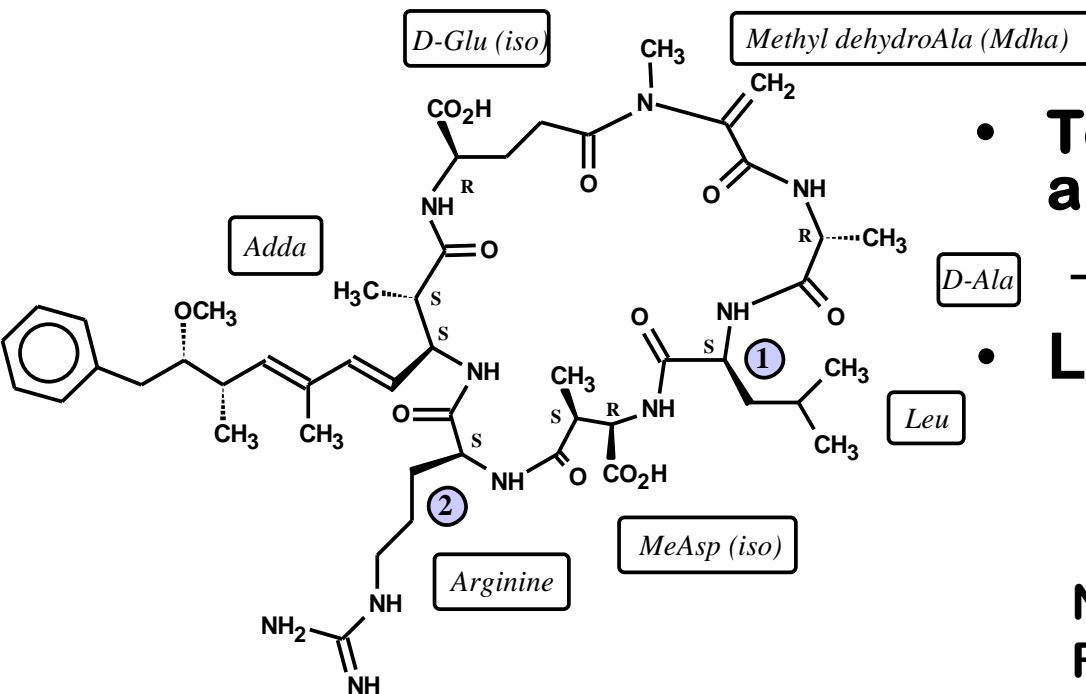
# What is the difference between *Microcystis* and microcystins?



- *Microcystis aeruginosa*
  - non-N fixer.
  - Likes organic N
  - forms surface blooms
- Very common genera
  - Found in every water body
- Can exist in toxic, non-toxic and potentially toxic forms.
  - Liver toxin called microcystins
  - Cell wall may be allergenic to some.

# Microcystins

- Family of toxins made by
  - *Microcystis* species
  - *Anabaena* species
  - *Planktothrix* species.
  - *Nodularia* species (halophytes)



- **Toxic and non-toxic species a morphologically indistinct**
  - DNA tools can tell them apart.

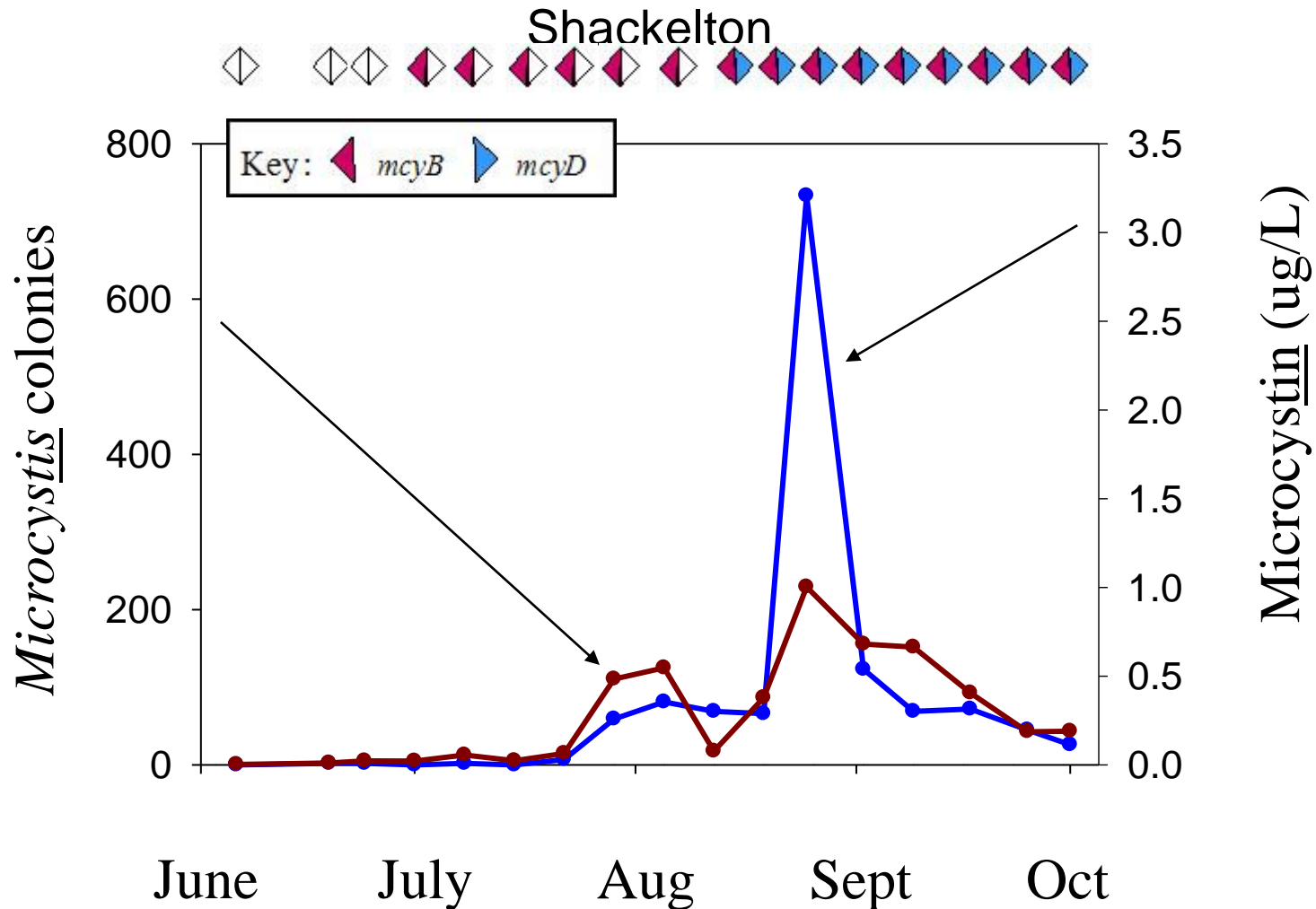
## • Liver Toxin

0.3 -1.6 ug/L (ppb) in DW  
4 ug/L in recreational water

NOT Bio-accumulated  
Rapidly metabolized

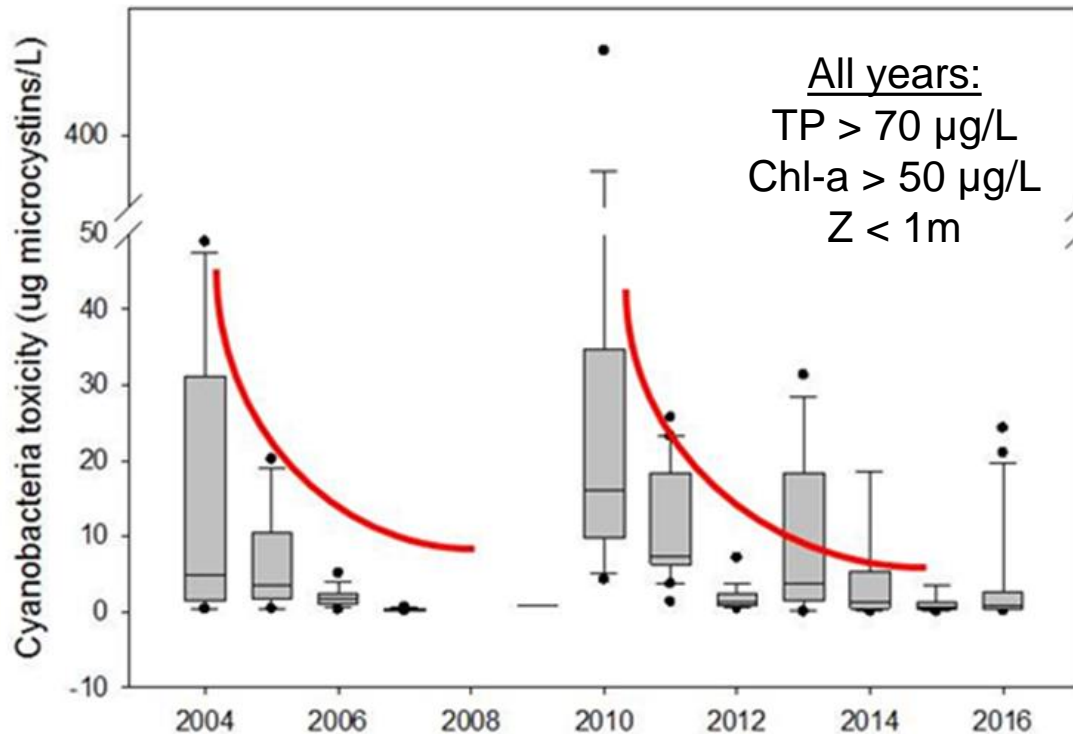


# Toxin Production in Oneida Lake, 2003



*Hotto et al, Environ. Toxicol 2005*

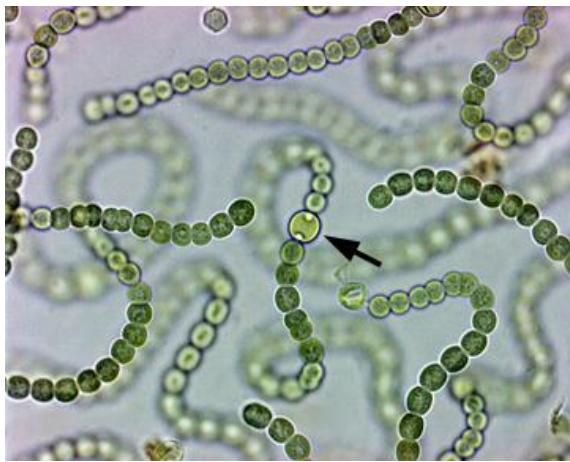
# Phosphorus is important for algal biomass, but other factors are important for toxicity.



Factors that affect toxicity include:

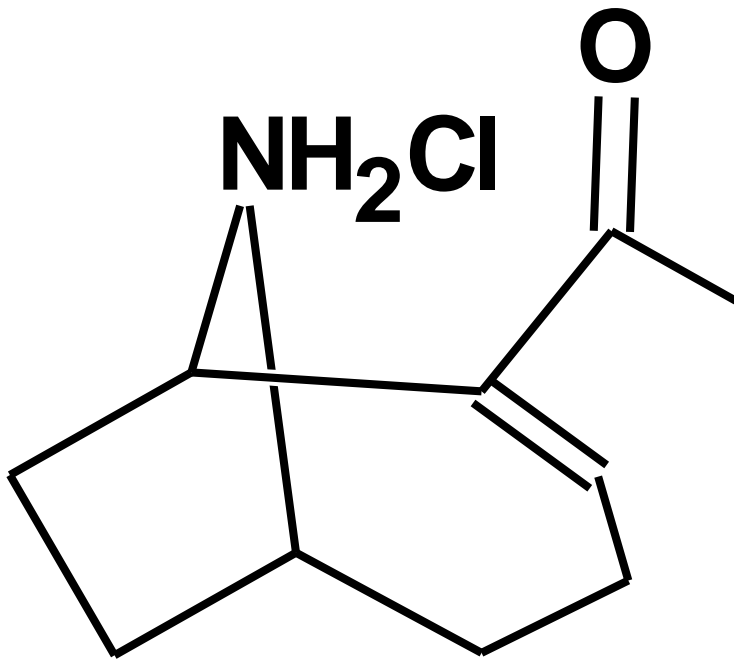
- Algal species
- Nitrogen, Iron
- Light
- Competition
- Bacteria





# Anatoxin-a

- **Potent Neurotoxin.**
  - LD-50: 200  $\mu\text{g kg}^{-1}$  (less toxic?)
  - Smaller molecule, fewer types
    - Much less stable
    - Harder to collect and test
  - Responsible for a number of animal fatalities.
  
- **Causative organisms (?) include:**
  - *Anabaena species (many)*
    - *Dolichospermum*
  - *Oscillatoria sp.*
    - *Planktothrix / Aphanizomenon*
  - *Benthic sources (Phormidium?)*
  - *Different nutrient requirements*



# Other toxins rare in CNY (but common on the internet!)

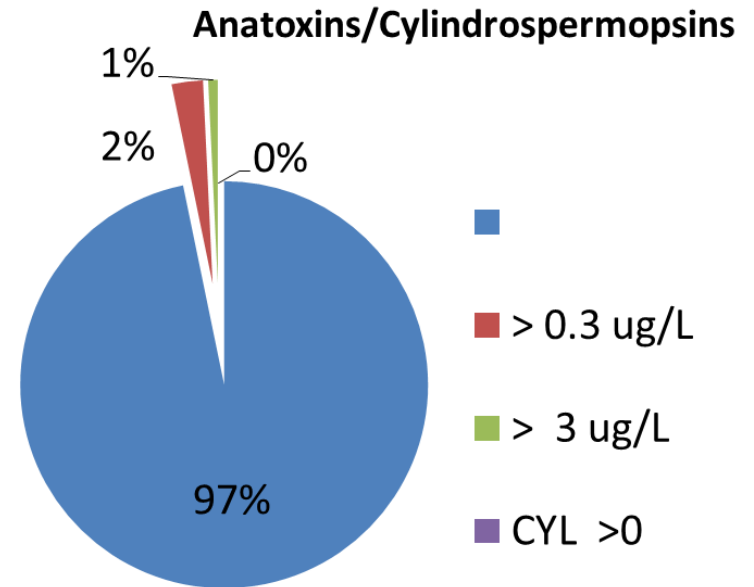
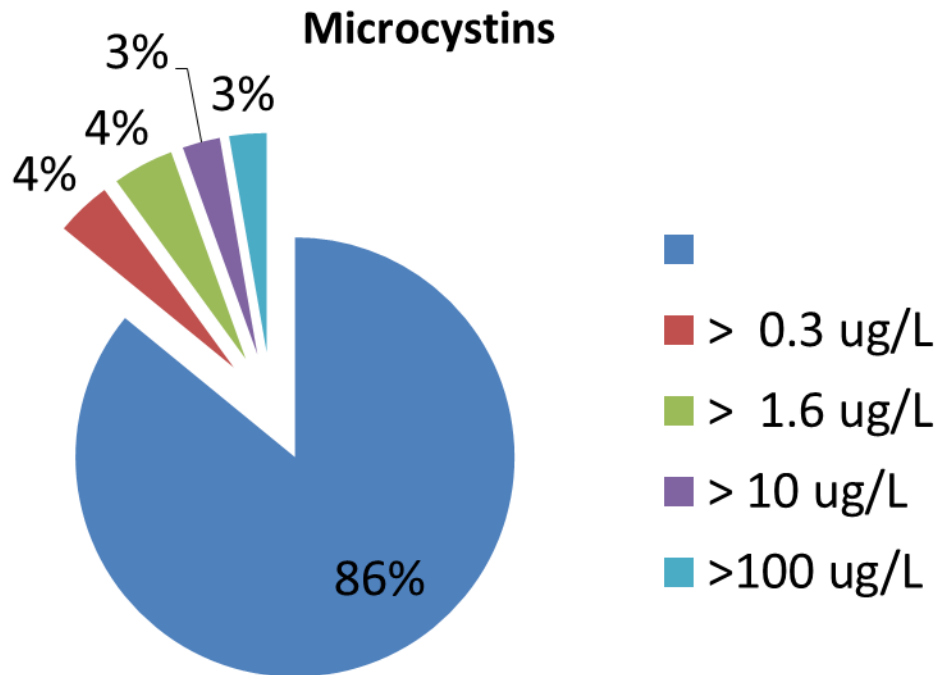
- Cylindrospermopsins  
(Florida)
- $\beta$  Methyl amino alanine  
(ALS-like symptoms)
- Dermatoxins
  - Allergic response to cells
  - Real dermatotoxin
- Others like PST toxins



Lyngbya rash/blisters  
- glboyer@esf.edu

# Big Picture Overview of New York Lakes

Microcystins in about 14% of our samples

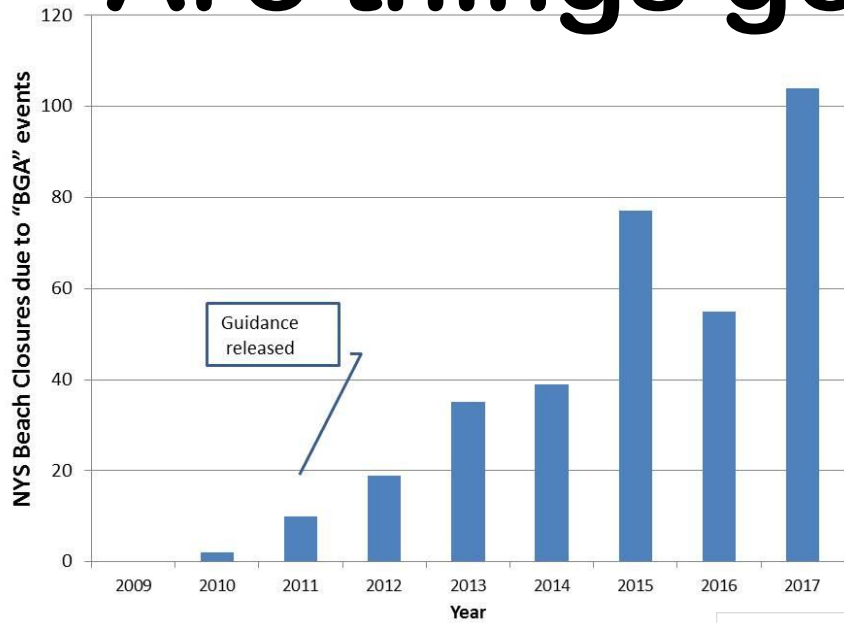


Anatoxin-a in about 3-4% of our samples

*2015-2017 data; n ~ 4800*

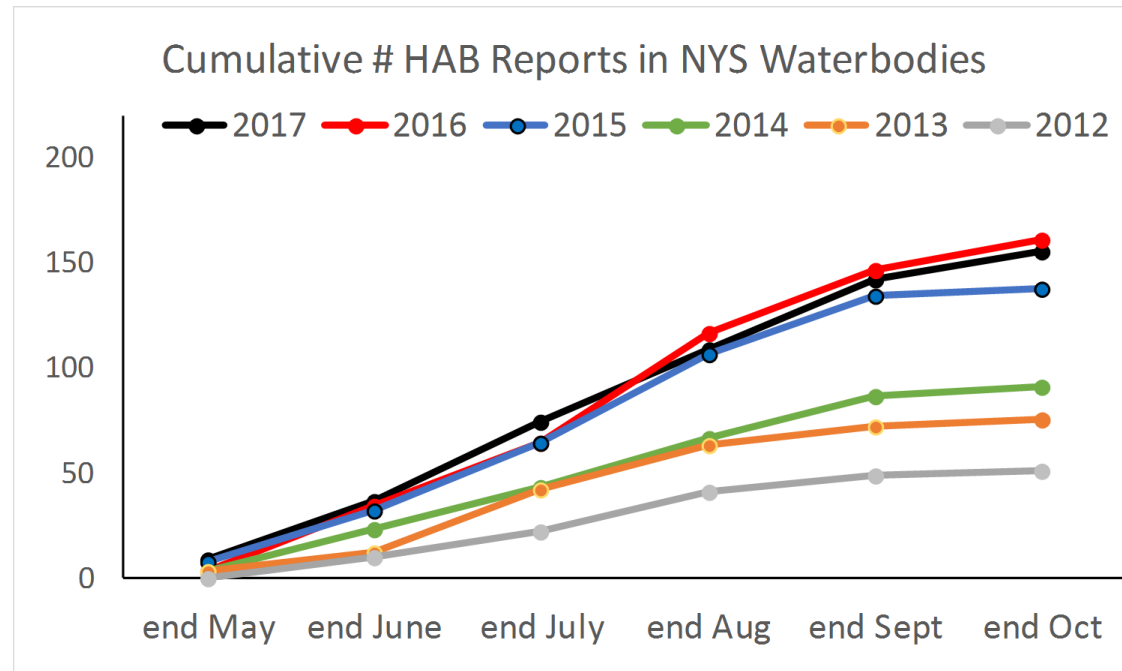


# Are things getting worse? .....



Beach closures at NYS parks reported to the DOH have steadily increased;

Over 160 water bodies were reported to the DEC HAB network last year;



# Consider what happened in the Finger lakes this year....

Frequency of Toxic and Non-Toxic Finger Lake cHABs								
	2010	2011	2012	2013	2014	2015	2016	2017
Canandaigua	48					49		632
Cayuga	16				0.0		14	729
Honeoye	372			8887	6.0	83	5.2	4.7
Keuka								624
Otisco								0.6
Owasco		2800		38	.0	862	0.0	1803
Seneca					0.0	67	0.0	390
Skaneateles								195
Hemlock								0.0
Canadice								0.2
Conesus							0.0	1.1

First time ever we had HAB events in all 11 lakes.....

# Lets keep things in perspective

*“And all the waters that were in the river turned to blood. And the fish that were in the rivers died; and the river stank, and the Egyptians could not drink the water of the river, . . .”*

***Exodus 7:20-21***

- Blooms are not new.
- Long term solution is by nutrient control.
- Avoid contact as you cannot separate good from bad blooms by looking.
- Careful of pets and small children.
- Enjoy your lake (outside of the bloom)

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