

Algal Toxins 101. An introduction to Algae and Algal toxins

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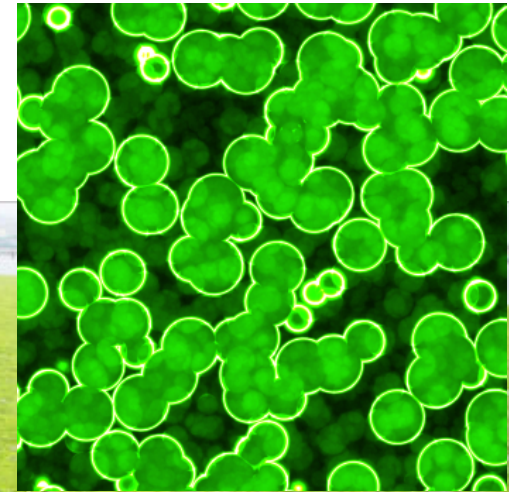


- Introduction to algae
- Harmful algal blooms
- Why they occur
- How do we monitor

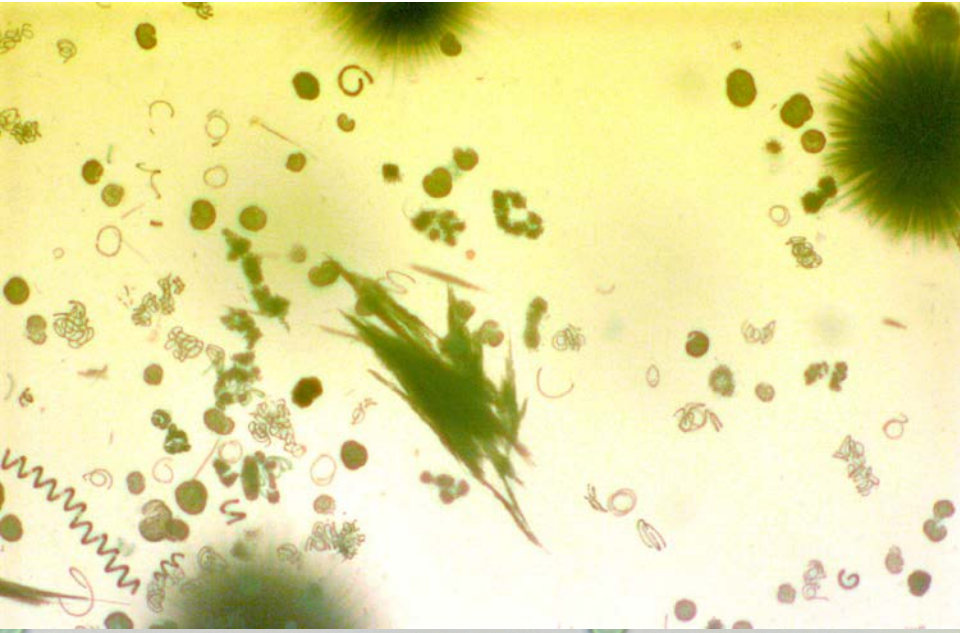


Q1. What are algae?

Simple plant-like organisms that live in the water. Use carbon dioxide and light to grow. Contain pigments -green algae, brown algae, diatoms, etc.

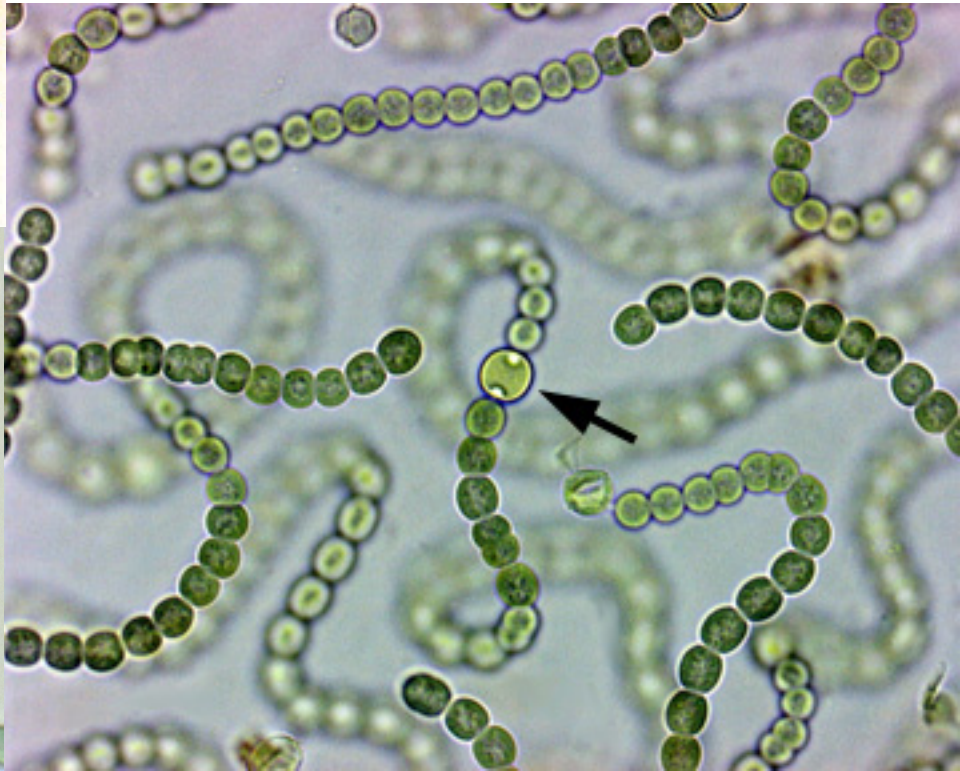
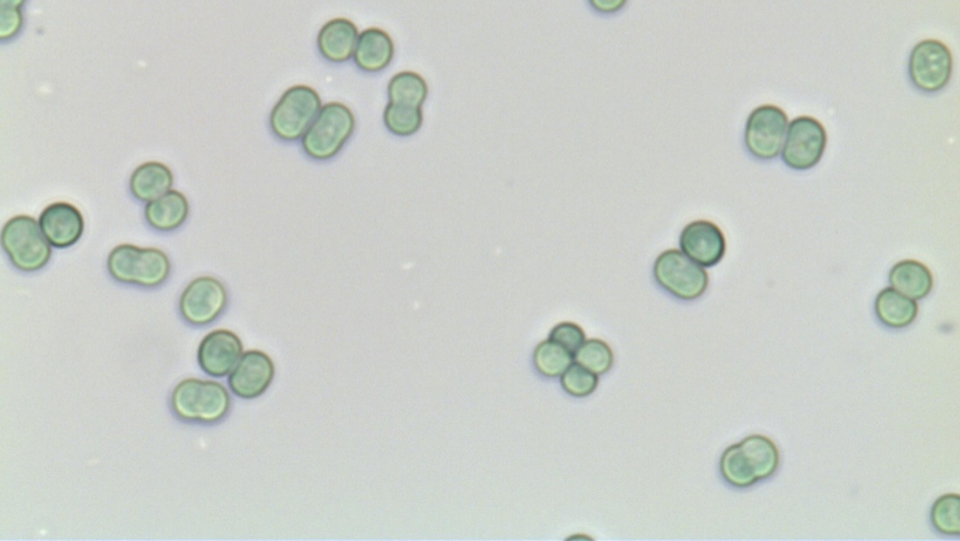


Q2. What are blue-green algae?



Plant-like bacteria called:
“Cyanobacteria”

Common name Blue-Green alga
Poor food source



Q3. Can I tell blue-green algae from others when I see it?

Blue and white crust forming on bloom that is decaying



Lake Champlain bloom





Blooms often
concentrate at
the shoreline or
along docks.





Blue tint within an algal bloom

Small cells spread throughout the water column

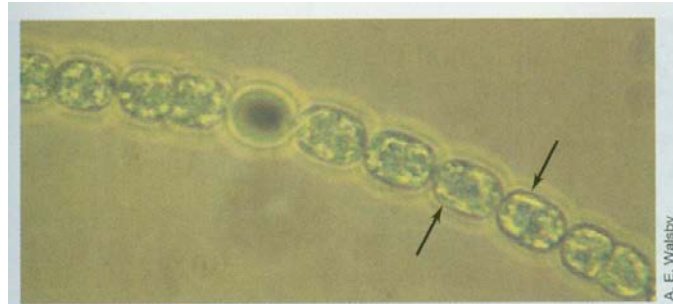


Some are big ball-like colonies

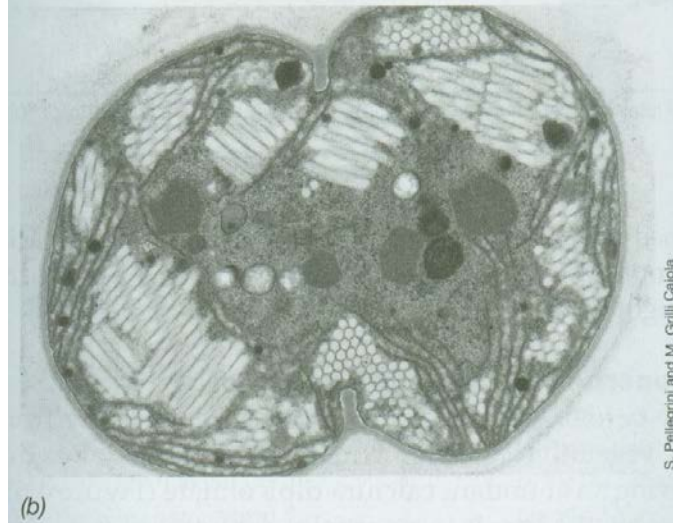


Lake Champlain

Blooms form surface accumulations



(a)



(b)

Conesus Lake



Gas bags in *Anabaena* and *Aphanizomenon* let them float.

Not every bloom or every scum is cyanobacteria. .



**Green (and Slimy)
Algae**



Spirogyra and
Mougeotia

More Green Algae



Cladophora



Ulothrix



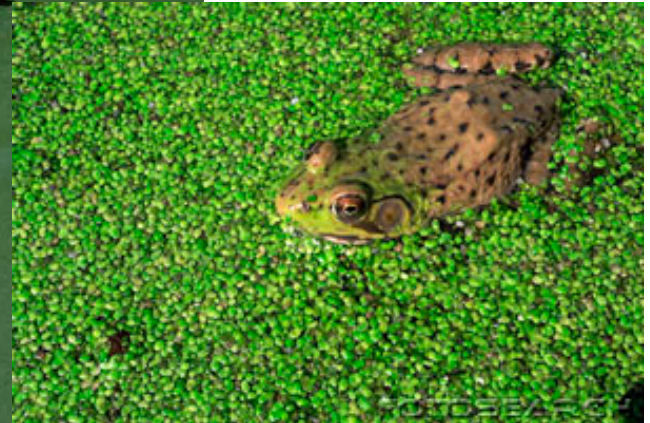
Spirogyra

Even more Green Algae



Euglena

Duckweed (higher plant)



Pollen (higher plants)



A. Shambaugh 2005



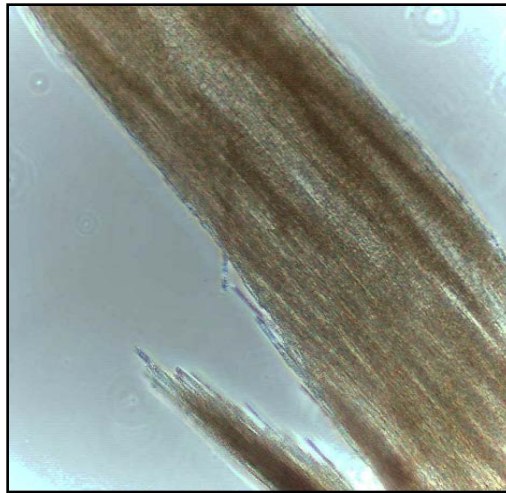
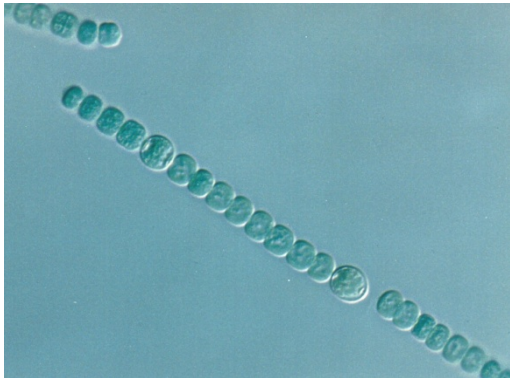
Probably not blue-green algae if...

- Material is bright green in color
- Consists of long cohesive strands
- Is attached to rocks, debris or the sediment surface rather than free-floating
- Has leaves or other “structures”

Point – Can not be sure it is cyanobacteria without looking under a microscope.

Pretty easy to tell under a microscope...

Anabaena



Aphanizomenon

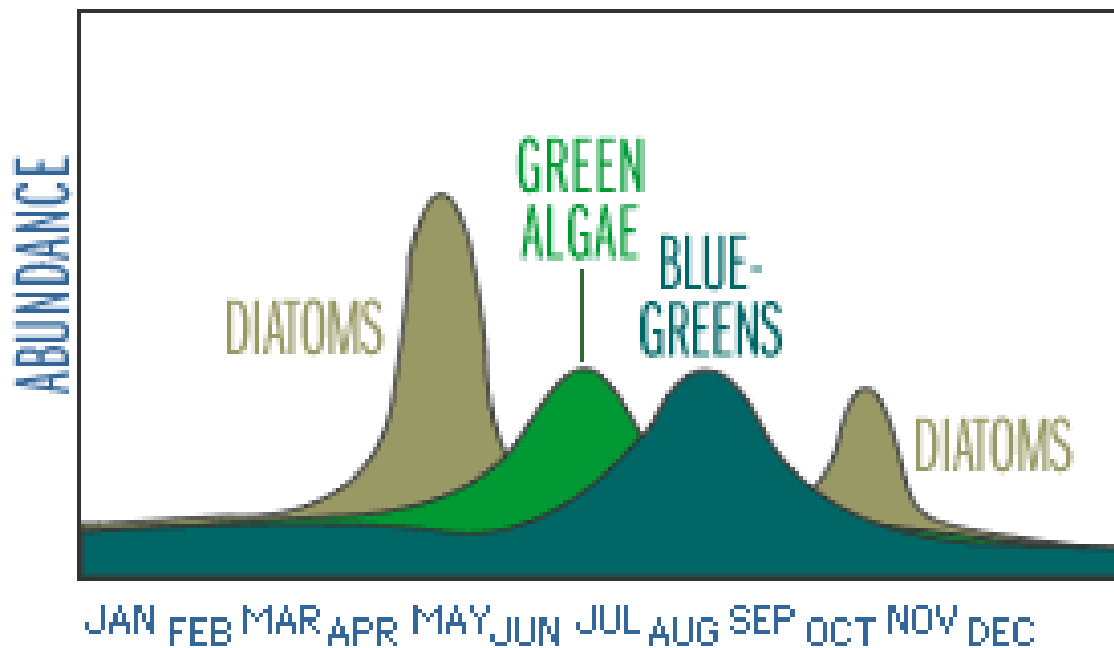


Microcystis

*Known to a generation of scientists as Anni, Fanni and Mike
(3 most common bloom forming species)*

Q4. When do Blue-green algal blooms normally happen?

SEASONAL SUCCESSION OF PHYTOPLANKTON POPULATIONS



Blue-greens usually show in late summer but can be anytime

Diatoms eat fast, Green algae are efficient, Blue-green algae cheat

Q5. So why do we care about them?

Some (not all) BGA can be harmful:

- liver toxins or hepatotoxins.
- Neurotoxins
- Other very nasty compounds
 - Swimmers itch
 - Alzheimer's-like agents.

When they die – they use up oxygen.

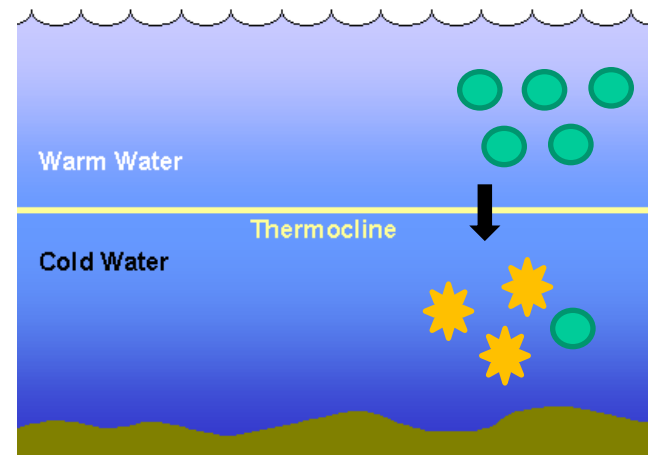


Q6. Do Blue-green algae kill fish?



Not directly

- Marine toxins (FL red tides) kill fish directly
- Blue-green algae grow too much
- When they die, it depletes oxygen in the water
- Fish suffocate




Q7. Who makes these toxins?



Microcystis makes
a family of toxins
called microcystins.

(remember Mike?)

- *Microcystis aeruginosa*
 - non-N fixer.
 - Likes organic N
 - forms surface blooms
- Very common genera
 - Found in every lake in the US
- Not all *Microcystis* is toxic
-  Microcystins are potent toxins
(40x more toxic than cyanide)
- Toxin is very stable to boiling
 - 1 ug/L allowed in drinking water
 - 20 ug/L for recreational contact

Q8. Has anyone ever died from these toxins?

Not in the US. Most affects are with animals:

.....associated with the *Anabaena Flos-aquae* bloom were estimated deaths of 5000-7000 gulls, 560 ducks, 400 coots, 200 pheasants, 50 squirrels, 18 muskrats, 15 dogs, 4 cats, 2 hogs, 2 hawks, 1 skunk, 1 mink, plus numerous song birds.

Storm Lake, Iowa, 1952

Q9. What happened in Toledo last year?

State of emergency declared in Lucas County after toxins found in Toledo water - Toledo Blade#o1BSAaAKupv3UJW0.03

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State of emergency declared in Lucas County after toxins found in Toledo water

Microcystin found in samples; boiling not recommended

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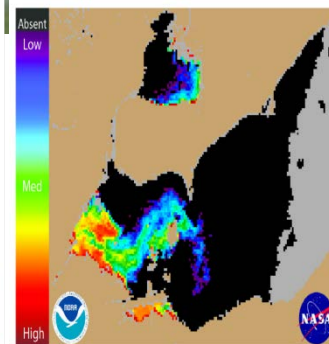
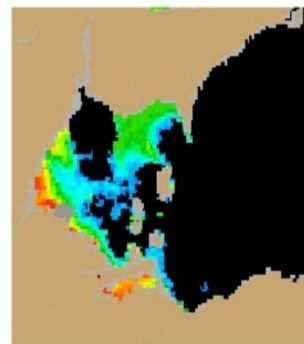


Scenes like this were comm on this morning as area residents traveled all over in search of bottled water.
THE BLADE/JETTA FRASER. [Enlarge](#) | [Buy This Photo](#)

A state of emergency was declared today in Lucas County and the greater Toledo area after tests at the Collins Park water-treatment plant in East Toledo produced two toxin sample readings.

Chemists testing water at Collins Park plant found two sample readings for microcystin that exceeded the recommended "do not drink" standard of one microgram per liter standard.

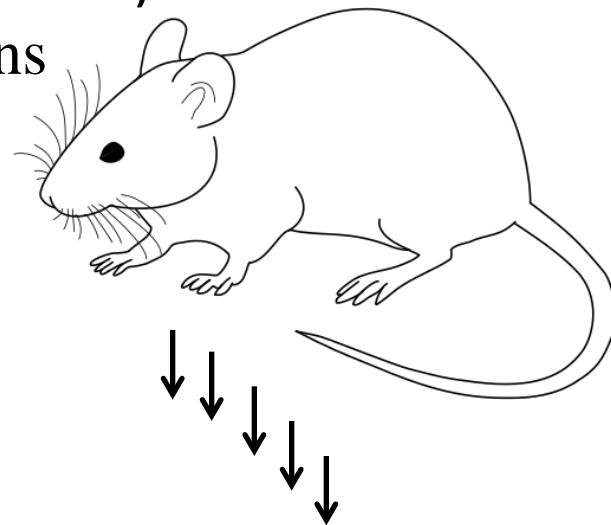
Toledo Mayor D. Michael Collins and health leaders asked residents to remain calm and said they may have answers later today on when Toledo-area water supply will be safe to drink again.



Q10. Was the water unsafe?

How do you determine safe levels of toxin in water?

- Start with a mouse
- Measure the highest level that has no effect.
 - No Observed Adverse Effect Level (NOAEL)
 - 40 $\mu\text{g}/\text{kg}$ body weight for microcystins
- Include safety factors
 - 10x (mice are not people)
 - 10x (not every mouse is the same)
 - 10x (limited number of studies)
- Average body weight of adult
- Consume 2 L water per day for life



World Health Organization Guideline value:

= 1 $\mu\text{g} / \text{L}$ (ppb)

(guideline value – not regulatory)

(EPA currently has no guidelines; most states use the WHO values)



Q11. Can what happened in Toledo happen here?

(maybe)

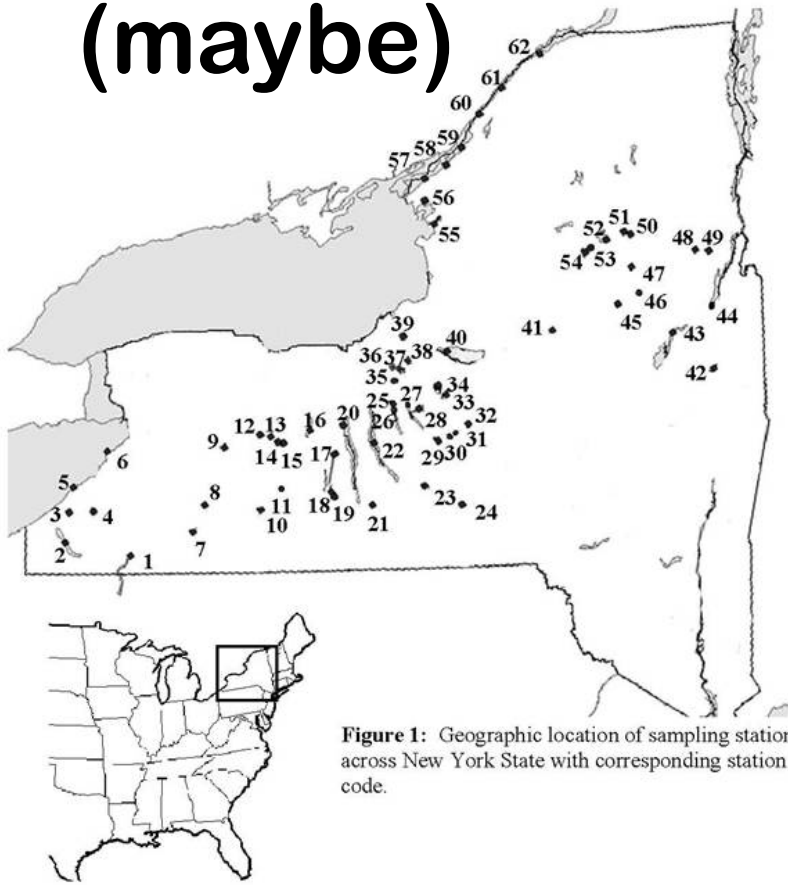
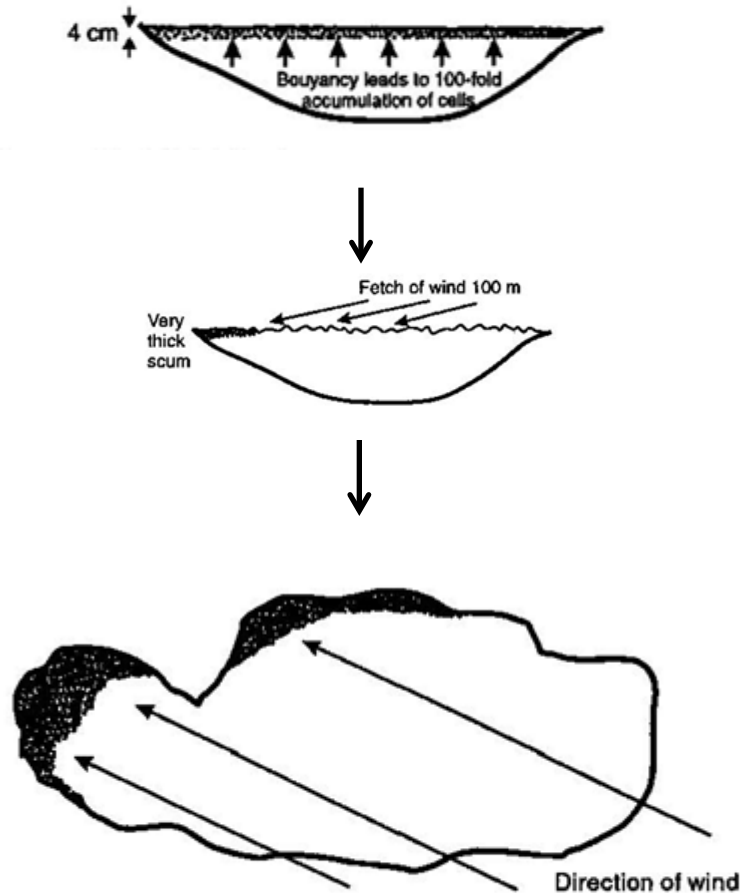


Figure 1: Geographic location of sampling stations across New York State with corresponding station code.

- Microcystis and microcystins are very abundant in NYS.
 - Half of our samples tested have the potential.
 - About half made toxin.
 - About **10-15%** of samples are at levels of concern for drinking water. (>1 ppb)
- potential \neq production
- In Toledo, the algae were concentrated by the wind
- More algae = more likely that it will be toxic.

Careful of wind concentrated scums.



2014 CSLAP results

Open water samples

- 865 samples
- 2 positive (0.23%)
- Range (1.1 – 1.4)

“Bloom” Samples

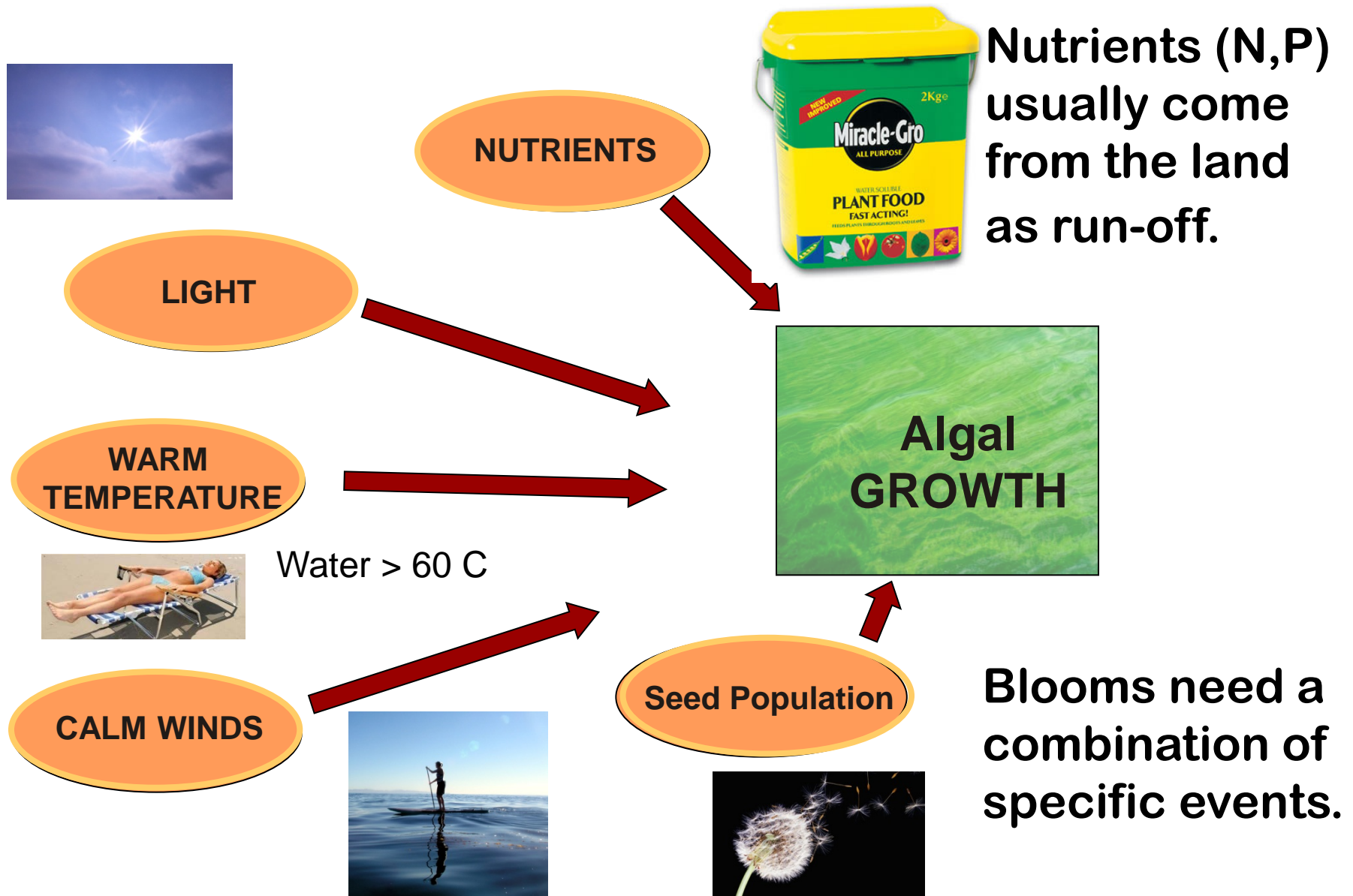
- 290 samples
- 70 positives (24%)
- Range (0.3 – 7,710)

Q12. Who is most at Risk?

- Pets!
- Small children.
- People or animals who must drink from marginal water supplies for long periods of time.



Q13. Why do blooms occur?



Q14. What can I do to prevent a bloom?



Reduce nutrients

Blooms need
Phosphorus to
grow



Calm waters



Wind can prevent a
bloom from growing



Tai Hu, China

Water temperature
must be above 50°F



Q15. What do I do if I see a bloom?

- 1. Remember not all blooms are toxic.**
- 2. If it is a bloom, avoid contact.**
- 3. Be careful of surface accumulations where the algae may pile up on the beach. Don't let young children "eat" the seaweed.**

Be careful of blooms attached on other plants (long black hair)

- 4. If your pet gets into the water, wash them off with clean water from a hose.**



Bonus Questions?

If not now – then free to ask
them later in the comfort of
your home.

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And thanks to all those who have donated pictures!