Cyanobacteria:

A Planktonic Supervillain

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SŌLITUDE LAKE MANAGEMENT

Restoring Balance. Enhancing Beauty.

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From Superhero…

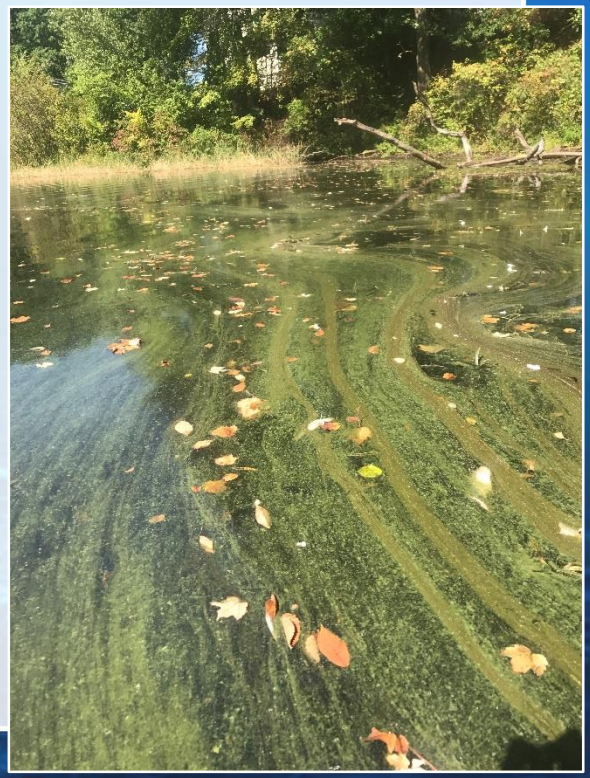
A naturally occurring primary producer

- Bacteria
  - Once called blue-green algae
  - Photosynthetic, and some Nitrogen-fixers
- Oldest known fossils
  - 3.5 billion years old
  - Assisting and creating a suitable atmosphere
  - Origin of plants through endosymbiosis
- Present in a variety of environments
  - Freshwater to marine
  - Some terrestrial, dependent on rain events
  - Common symbionts with vegetation
  - Integral part of food web

…To Supervillain

An easily aggravated type of Harmful Algal Bloom (HAB)

- "Everything they built will fall, and from the ashes of their world, we'll build a better one." – Apocalypse, *X-men: Apocalypse*
- Purpose: endangering public safety, the economy, and wildlife
- Appearance: bright blue-green, slightly slimy
  - Also HABs of green algae, golden-browns, diatoms, etc.
- Reality of HABs
  - Any bloom condition that is directly toxic or causes toxic conditions. Affect people & wildlife. Illness or death.
  - The result of a larger problem
  - Cyanobacteria are primary offenders



The Creation of the Supervillain

A reaction to adversity or change

- Naturally occurring
  - environmental shifts
  - natural disturbance
- Weather patterns (natural or anthropogenic)
  - Temperature
  - Climate change: microclimates count
- Nutrient availability/pollution
  - Increase in standing water: stormwater ponds, fire ponds
  - Development/impervious surfaces
  - Urban run-off: fertilizer, pet waste, road treatment
  - Organic materials: leaf-litter, grass clippings, brush
  - Human-born disturbance

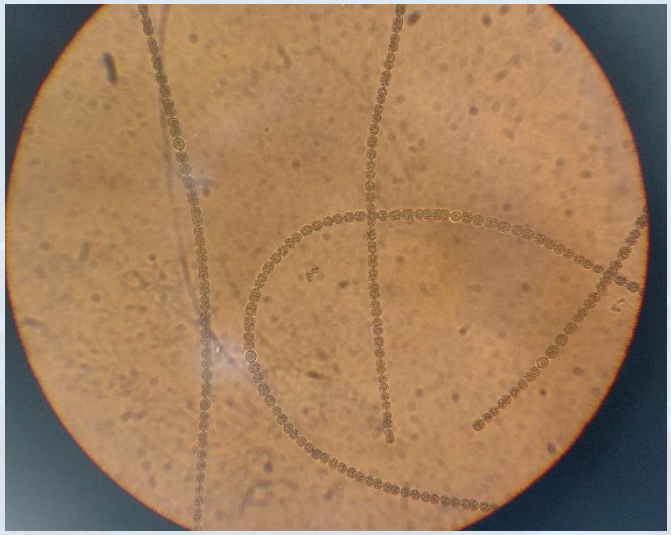
How Are They Toxic/Harmful?

The problems that they create or instigate

- Harmful aquatic conditions: before, during, after
  - Reduce or eliminate photic zone (plant/phyto/zooper decrease)
  - Clog fish gills
  - Poison shellfish
  - Decrease invertebrate reproduction
  - Alter resident plankton community
  - Large quantity consumption of oxygen
- Economic impacts
  - Decreased property value
  - Human sickness: lost wages, work days, medical treatment, investigation
  - Commercial fisheries & hatcheries
  - Recreation/Tourism degradation
  - Drinking water contamination
  - Monitoring/Management

Continued: How Are They Toxic/Harmful?

- Toxin production
  - Still being researched
  - Cyanotoxins: hepato-, neuro-, derma-
  - BMAAs (β-Methylamino-L-alanine)
  - Effect all taxonomy: bacteria, algae, invertebrates, plants, and animals
  - Topical irritation to physical discomfort to hospitalization.
  - Long term effects: ALS, Alzheimer's disease, Parkinson's disease, and cancer



Where Do Cyanotoxins Go? Still Being Researched

- Aerosol emissions
  - Lake Spray Aerosol (LSA) produced from spray or water movement
- Leaky cell
- Post-bloom toxin degradation
  - Copper algaecides heighten toxin degradation?
- Adsorption into sediment?
- Movement through food web: blueberries, crops, apex predators (loons)
- Plants, lichens & fungi through symbioses

Toxic Puzzle – Hunt for the Hidden Killer (2017) by Bo Landin

Tactics to Prevent, Predict & Manage

Stop goading the villain, we're asking for it…

- BE PROACTIVE → Reduce nutrient pollution
  - Improve shoreline buffer zones
  - Phosphorus-free fertilizers, detergents, car soap
  - Aeration, if applicable
  - Pick up pet waste (or any litter), even if it's not yours
  - Xeriscaping, for ground water filtration
  - Additive-free septic systems
  - Install tertiary treatment at wastewater treatment facilities
  - Remove grass clippings and leaves after lawn maintenance
  - Monitoring
  - Reduce fossil fuel consumption
  - Education/Outreach: pamphlets/handouts, launch postings, clean-up events, community involvement

Ultimately, its best to prevent a bloom from happening than to deal with one.

Continued: Tactics to Prevent, Predict & Manage

Monitoring, monitoring, monitoring

- Active Monitoring (Biological/Chemical)
  - Algae ID and counts
  - Water quality/nutrient analysis
  - Impact analysis of point & non-point source pollution
- Passive monitoring (Physical/Visual)
  - Awareness of waterbody characteristics and where cyanobacteria may concentrate (coves, wind-concentrated)
  - Note discoloration, changes in water color
  - Nearby development

Water quality monitoring can forecast bloom formation, and additional screening can determine toxicity, if any.

Continued: Tactics to Prevent, Predict & Manage

Prediction allows preventative management rather than reactive control

- Preventative Management
  - Phosphorus-binding products
  - Watershed management
  - Water column mixing
    - Aeration
    - Circulation
    - Oxygenation
  - Bacterial augmentation
  - Activated charcoal
  - Sonic waves
- Reactive Management
  - Not ideal, but sometimes necessary
  - Copper algaecides/non-copper algaecides

Informational References

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Thank you!

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