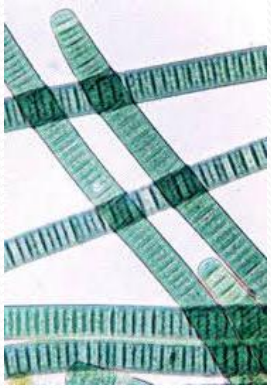
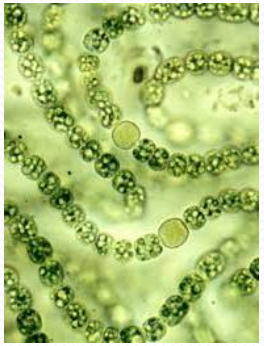
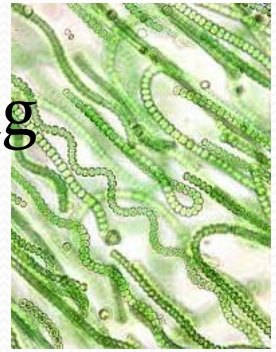
White Pond cyanobacteria (blue green algae) bloom July 2015

What are Blue Green algae?



- Cyanobacteria
- Phylum of bacteria that obtain their energy through photosynthesis.
- At least 2.7 billion years old
- By producing oxygen as a byproduct of photosynthesis, cyanobacteria are thought to have converted Earth's early reducing atmosphere into an oxidizing one, causing the "rusting of the Earth" and dramatically changing the composition of life forms on Earth

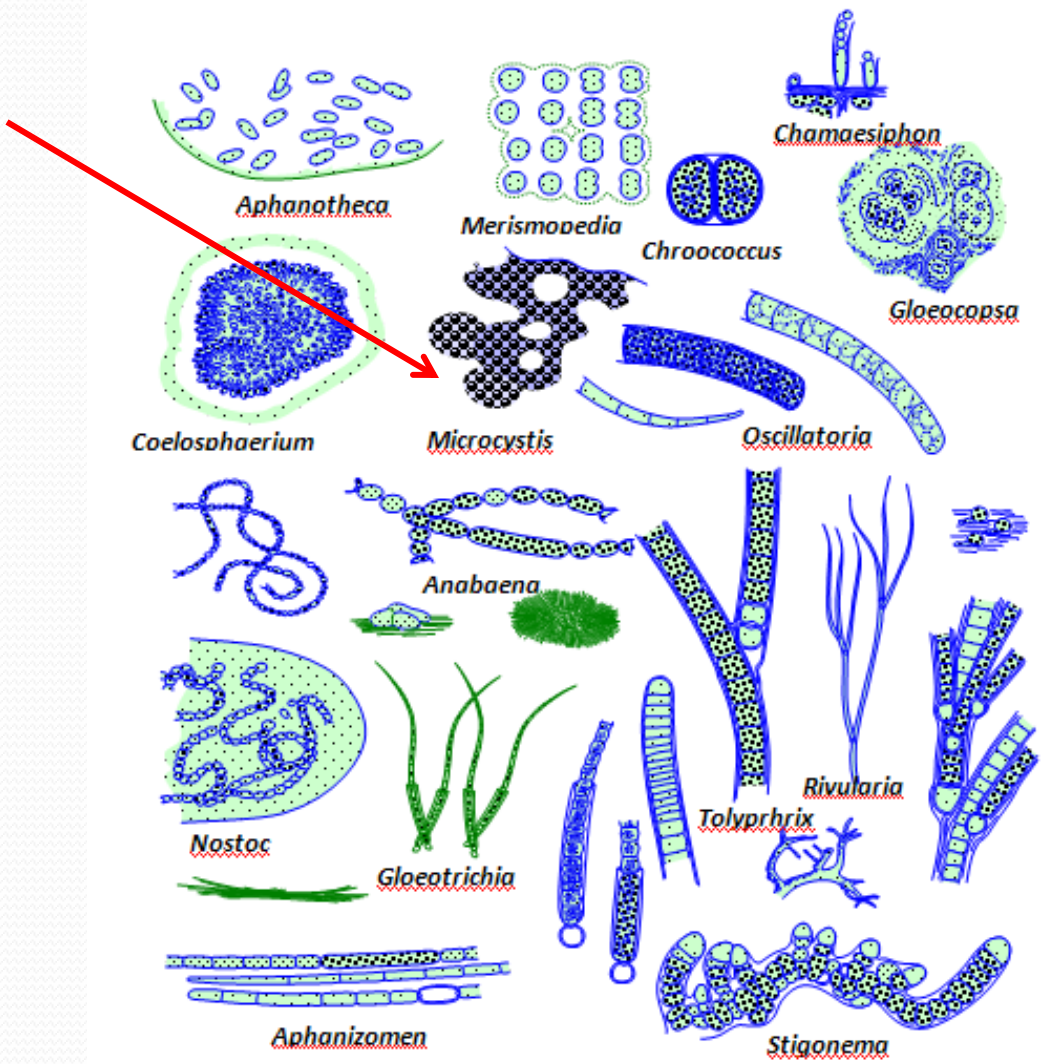




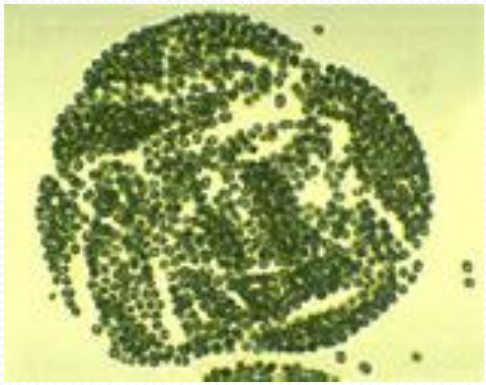
What are Blue Green algae?

- Can be found in almost every terrestrial and aquatic habitat—oceans, fresh water, damp soil, temporarily moistened rocks in deserts, bare rock and soil, and even Antarctic rocks
- Arguably the most successful group of microorganisms on earth. They are the most genetically diverse; they occupy a broad range of habitats across all latitudes, widespread in freshwater, marine, and terrestrial ecosystems.
- Fulfill vital ecological functions in the world's oceans, being important contributors to global carbon and nitrogen budgets.

What are Blue Green algae?



- Many species
- Come in many shapes
- Some produce toxins, others do not.
- Microcystis is one of the most common.



What causes blooms of algae?

In freshwater--

- Blue--green algae naturally occur in water bodies but do not cause problems at low concentrations
- Can grow at an exponential rate and cause scums or blooms in the water. Some types can produce toxins harmful to people and animals.
- Certain weather conditions and excess nutrients contribute to bloom formation.
- Some sources of nutrient inputs: fertilizers, agricultural runoff, septic systems, storm water runoff.
- Periods of rain followed by hot, sunny weather lead to increased growth.

Are Blue Green algae blooms unique to White Pond?

- No--they are an increasing problem nationwide, due to human-induced nutrient loading of freshwater bodies.
- MDPH Bureau of Environmental Health/Environmental Toxicology staffed new Algae Control program in **2009** in response to several dog deaths and blue-green blooms in ponds on Cape Cod and elsewhere in MA.

- MDPH Cyanobacteria Advisories in Massachusetts current as of July 31, 2015
  - Brookline Reservoir (not used for drinking water) - Brookline
  - Jamaica Pond - Boston
  - Lake Attitash - Amesbury
  - Savery Pond - Plymouth
  - Schoolhouse Pond - Barnstable
  - West Monponsett Pond - Halifax, Hanson
  - White Pond - Concord
  - Willis Pond - Sudbury

MDPH sampling protocol and rationale

- MDPH's role is to protect public health, not to determine what caused bloom or resolve problem.
- MDPH will sample when notified of bloom.
- Samples identify and enumerate algal type and test for toxin levels (if species found is a toxin producer).

- Sampling Procedure:
  - Samples collected at 1 meter depth, six inches below the surface (same protocol as beach testing program).
  - Depth is fixed but lateral location is not.
  - Sampling site is chosen based on bloom appearance to target worst case scenario.
  - Samples placed on ice and analyzed for cell count and identification within 24 hours of collection.

MDPH sampling protocol and rationale

- Advisories are recommended when either a visible cyanobacteria scum or mat is present OR the analyses of water samples for algae cells or toxin levels exceed guideline levels:

  a. A cell count exceeds 70,000 cells/mL

  b. A microcystin toxin level exceeds 14 ppb

MDPH sampling protocol and rationale

- MDPH will continue to sample weekly while bloom persists.
- Will recommend lifting the advisory when 2 consecutive weekly samples are <70,000 cells/mL (assuming toxin levels are acceptable)

White Pond Bloom--Sequence of events

- June 29—Notified of possible ongoing bloom, visited pond and observed small amount (1 x 6 ft. patch) of mustard yellow floating algae by Dover St. beach.

June 23
Bill Walker picture

- July 5—Notified that larger floating bloom of yellow floating algae had been observed over the weekend of July 4-5.

July 5

White Pond Bloom--Sequence of events

July 6—Notified of large bloom of mustard yellow floating algae.

- Bloom stretched along shoreline from Stone Root Ln. beach to Thoreau Club boat launch, was 20-30 ft. wide and approx. 200 ft. long.
- Called MDPH for technical assistance.
- MDPH took water samples that afternoon at Thoreau Club boat launch and Stone Root Lane beach.

White Pond Bloom--Sequence of events

July 8--Bloom much more dense, bright mustard yellow floating scum.

- Bloom moving location around pond daily.
- Bloom observed along White Ave. shoreline, White Pond Associates beach, town cove area, and other areas.
- This necessitated closing entire pond.

White Pond Bloom--Sequence of events

Results of July 6 samples were received on July 8:

Sample 1: 160,000 cells/mL. Microcystin toxin 9 ppb

Sample 2: 130,000 cells/mL. Microcystin toxin 7 ppb

Results exceeded 2 MDPH criteria for closure:

Visible cyanobacteria scum

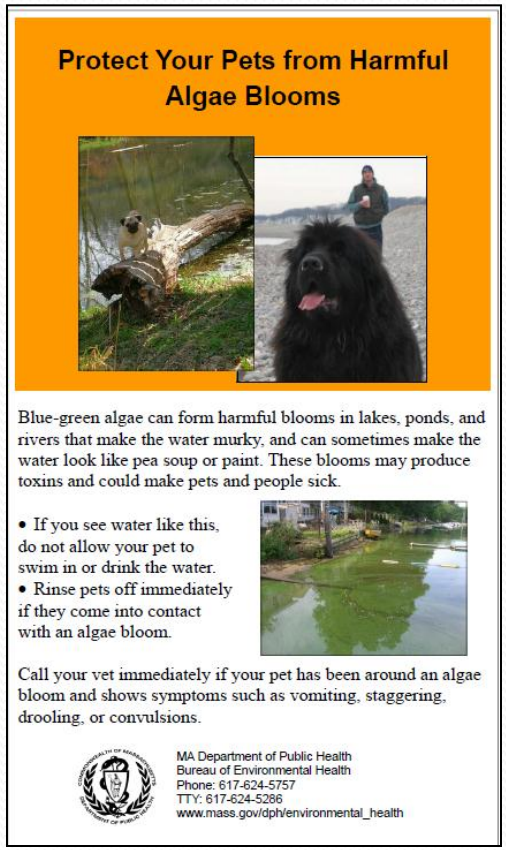
Cell counts >70,000 cells/mL

Toxin also present in significant amounts, although < 14 ppb.

Recreational Water Use Advisory issued

White Pond Bloom--Sequence of events

On **July 8**, the Board of Health issued a recreational water use advisory and posted signs around the pond



White Pond Bloom--Sequence of events

July 13 sample: bloom appeared very dense

Sample results: 320,000 cells/mL.
Microcystin toxin 9 ppb

White Pond Bloom--Sequence of events

July 20 sample: bloom appeared to be fading. Remnants still visible but much less dense.

July 20 results: 10,00 cells/mL.
Microcystin toxin <1 ppb

White Pond Bloom--Sequence of events

July 27 sample: bloom appeared to be fading; remnants still visible but much less dense and only in small patches. Sample take at White Pond Associates beach. Water appeared clear at time of sample—no visible bloom.

July 27 results: 130,00 cells/mL.

Microcystin toxin <1 ppb

Recreational Water Use Advisory remained in effect

White Pond Bloom--Sequence of events

August 3 sample: bloom remnants still visible at Thoreau Club boat launch area.
Sample take at White Pond Associates beach. Water appeared clear at time of sample—no visible bloom

August 3 results: 34,000 cells/mL.
Microcystin toxin <1 ppb

Recreational Water Use Advisory remains in effect
Next pond sample August 10;
Earliest possible date for reopening is August 12

Swimming beach bacterial testing

- Freshwater beaches are tested for E. coli or enterococcus
- These are **Indicator Organisms**
  - Many pathogens are not easily detected. Indicator organisms are a monitoring tool used to measure changes in water quality and/or potential presence of hard-to-detect target pathogenic organisms.
  - Indicator bacteria are usually harmless, more plentiful, and easier to detect than pathogens.
  - An indicator organism provides evidence of the presence or absence of a pathogenic organism surviving under similar physical, chemical, and nutrient conditions.

Swimming beach bacterial testing

- Freshwater tested for *E. coli* or enterococcus
- E. coli and enterococcus are both fecal bacteria i.e. live in the intestinal tract of warm blooded animals.
- Presence of either <u>may</u> indicate that fecal material is present
- Fecal material if present <u>might</u> include disease-causing bacteria and viruses
- Enterococci are believed to provide a higher correlation than fecal coliform with many of the human pathogens often found in city sewage.

Swimming beach bacterial testing

- BUT, these organisms are NOT specific to humans
- Many other sources:
  - storm water
  - dog waste
  - geese and other wildlife
  - heavily used beaches with limited water circulation
- Imperfect system. Beach closures happen.
  - usually don't last more than 1-2 days.
  - Beach regs revised 2015 to allow bacterial exceedances on **2** samples taken on consecutive days before closing the beach.
- **NOT related to algal blooms/nutrient loading.**

Questions?