Photo Credit: G. Zoto, MassDEP

MassDEP

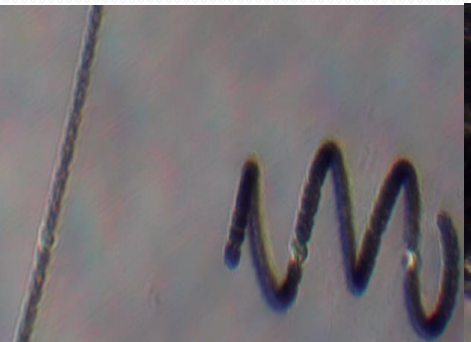
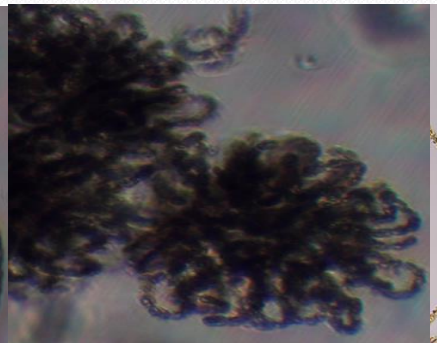
Cyanobacteria & Cyanotoxins: What PWSs should know

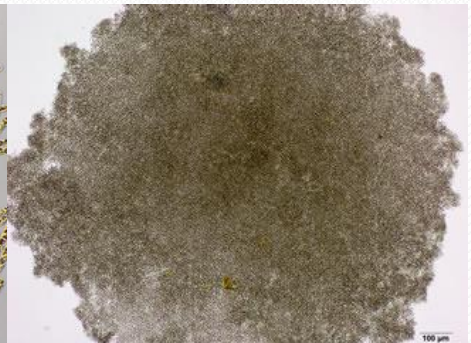
Massachusetts Water Works Association
Membership Meeting
March 15, 2018

Cyanobacteria: The Basics

- **Naturally occurring microorganisms (bacteria) formerly known as blue-green algae**
- **Present in all waterbodies in low numbers**
- **Cyanobacterial species number in the thousands**
- **Single cells, thread-like filaments or colonies and groups**
- **Grow as benthic or planktonic populations**
- **Four most common cyanobacteria in Massachusetts**

➢ Anabaena ➢ Aphanizomenon ➢ Microcystis ➢ Planktothrix



Cyanobacteria: Blooms

- Dramatic cyanobacteria increases can lead to cyanobacterial Harmful Algal Blooms (CyanoHABs)
- May cause dissolved oxygen, taste and odor, public health issues
- Discoloration

Cyanobacteria: Misidentifications

- Pollen
- Paint or dye spills
- Duckweed
- Green algae

CyanoHABs: Risk Factors

- **Predominant Indicators**

Potential for cyanobacterial blooms in waterbodies based upon environmental factors.				
Bloom Risk level	**History of Blooms**	**Water Temp °C**	**Total Phosphorous micrograms per liter (µg/L)**	**Thermal Stratification**
Very low	**No**	**<15**	**<10**	**Rare or never**
Low	**Yes**	**<15-20**	**<10**	**Infrequent**
Moderate	**Yes**	**20-25**	**10-25**	**Occasional**
High	**Yes**	**>25**	**25-100**	**Frequent and persistent**
Very high	**Yes**	**>25**	**>100**	**Frequent and persistent/strong**
Based on Newcombe et.al., 2010				

- **Reduced flow/high residence time**
- **Wind**

Cyanotoxins

Cyanotoxins Produced

- Anabaena – Anatoxins, Microcystins, Saxitoxins
- Aphanizomenon – Saxitoxins, Cylindrospermopsins
- Microcystis – Microcystins
- Planktothrix – Anatoxins, Aplysiatoxins, Microcystins, Saxitoxins

- **Intracellular and Extracellular**
- **Number of species that produce toxins is unknown**
- **Cyanotoxin identification requires laboratory analysis**

Cyanotoxins: Exposure & Health Effects

Exposure Routes

- Dermal, oral and inhalation

Health Effects

- **Dermatological Effects & Illness**
- **Hepatotoxins**
- **Neurotoxins**

Possible Reactions

- Rashes, abdominal pain, fever, vomiting, diarrhea, respiratory irritation, liver and kidney damage; and, and effects to the nervous system

USEPA Human Health Risks to Cyanotoxins Exposure:

https://www.epa.gov/nutrient-policy-data/health-and-ecological-effects#what1

CYANOTOXINS	ACUTE HEALTH EFFECTS IN HUMANS	MOST COMMON CYANOBACTERIA PRODUCING TOXIN
Microcystin-LR	Abdominal pain, Headache, Sore throat, Vomiting and nausea, Dry cough, Diarrhea, Blistering around the mouth, and Pneumonia	Microcystis, Anabaena, Nodularia, Planktothrix, Fisherella, Nostoc, Oscillatoria, and Gloeotrichia
Cylindrospermopsin	Fever, Headache, Vomiting, Bloody diarrhea	Cylindrospermopsis raciborskii, Aphanizomenon flos-aquae, Aphanizomenon gracile, Aphanizomenon ovalisporum, Umezakia natans, Anabaena bergii, Anabaena lapponica, Anabaena planctonica, Lyngbya wollei, Rhaphidiopsis curvata, and Rhaphidiopsis mediterranea
Anatoxin-a group	Tingling, Burning, Numbness, Drowsiness, Incoherent speech, Salivation, Respiratory paralysis leading to death*	Chrysosporum (Aphanizomenon) ovalisporum, Cuspidothrix, Cylindrospermopsis, Cylindrospermum, Dolichospermum, Microcystis, Oscillatoria, Planktothrix, Phormidium, Anabaena flos-aquae, A. lemmermannii Raphidiopsis mediterranea (strain of Cylindrospermopsis raciborskii), Tychonema and Woronichinia

***Symptoms observed in animals.**

CyanoHABs: Regulations/Guidance

EMERGING ISSUE: NO current federal or Massachusetts <u>regulations</u> for cyanobacteria or cyanotoxins

- **US EPA Health Advisories (HAs)**
- **US EPA Required UCMR4 Monitoring**
- **Massachusetts Department of Public Health (MDPH) Guidance (public beaches)**
- **MassDEP Guidance for Public Water Systems (PWSs)**

Photo Credit: David Zapotosky

US EPA DW Health Advisories

- **Two (2) HAs - microcystins and cylindrospermopsin**
- Non-regulatory concentrations at or below which adverse health effects are not anticipated to occur by oral ingestion of DW over specific exposure durations.

US EPA DW Health Advisories		
Cyanotoxin	US EPA 10-day HA	
	Bottle-fed infants & pre-school children	School-age children and adults
Microcystins	0.3 µg/L	1.6 µg/L
Cylindrospermopsin	0.7 µg/L	3 µg/L

Cyanotoxins Monitoring: UCMR4

- **Cyanotoxins Sampling between 2018-2020**

- **Ten (10) Cyanotoxins: total microcystins, microcystin-LA, microcystin-LF, microcystin-LR, microcystin-LY, microcystin-RR, microcystin-YR, nodularin, anatoxin-a, and cylindrospermopsin**

- **Data from the UCMR serves as a primary source of research information, which US EPA utilizes to develop regulatory decisions.**

- **Three (3) US EPA approved methods for drinking water**
  - **EPA 544** (LC/MS/MS – MC/NOD)
  - **EPA 545** (LC/MS/MS – CYN/Ana)
  - **EPA 546** (ELISA – MC/NOD)

For further information on UCMR4 and cyanotoxins assessment monitoring, please see: **https://www.epa.gov/dwucmr/fourth-unregulated-contaminant-monitoring-rule**.

Cyanobacteria: MDPH Guidance

- MDPH has developed health-based guidance levels for recreational exposure to cyanobacteria.

- MDPH recommends that beaches be posted and individuals limit all contact with a waterbody if the waterbody has cyanobacteria cell counts exceeding 70,000 cells/milliliter (mL) or microcystin concentrations that meet or exceed 14 micrograms per liter (µg/L).

Online Photo Credit: US EPA

Coming Soon: MassDEP Guidance

- **Collaborative Development**
  - MDPH, Office of Research and Standards (ORS)
  - Regional DW Programs, Watershed Planning Program (WPP)
  - Safe Drinking Water Act Advisory Committee (SDWAAC)

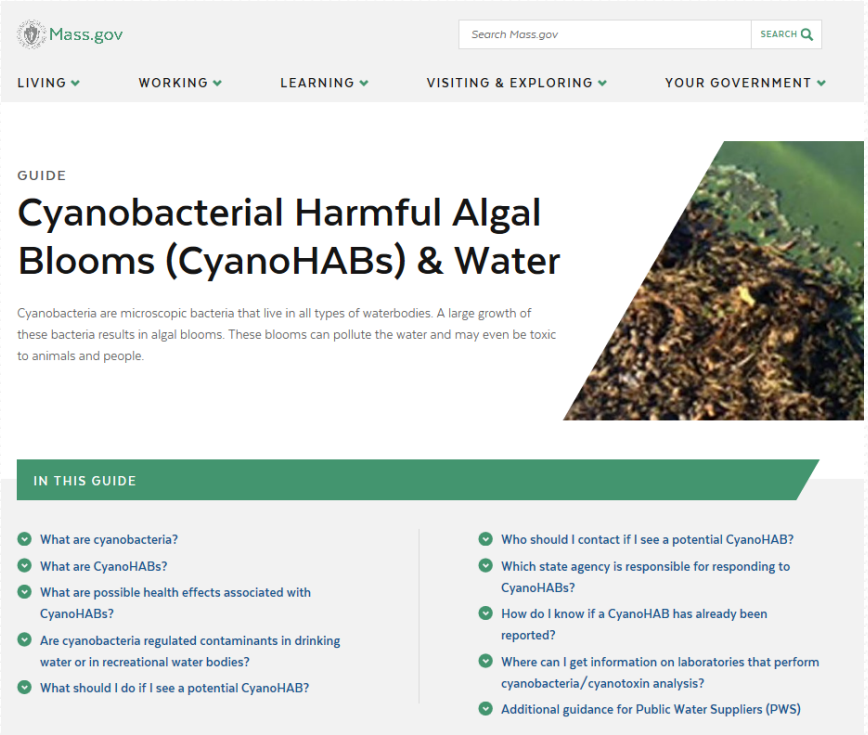
- **Watershed Management & Source Water Protection Focus**
  - Cyanobacteria/Cyanotoxin Information
  - Critical factors for assessing source vulnerability
  - Fact Sheet & PWS Bloom Tracking Form
  - Treatment options
    - In-reservoir & within treatment facility
  - Additional resource materials and MassDEP contacts

- **Website Update & Internal/Interagency Protocols**

Helpful Resources

US EPA Website: https://www.epa.gov/nutrient-policy-data/cyanohabs

MA EOEEA Website:
https://www.mass.gov/guides/cyanobacterial-harmful-algal-blooms-cyanohabs-water



MDPH Website:
https://www.mass.gov/lists/algae-information

University of New Hampshire Online Guide:
http://cfb.unh.edu/CyanoKey/indexCyanoQuickGuide.htm


SAFETY FIRST!

CyanoHAB QUESTIONS/COMMENTS?

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