

Human Health Risks Associated with HABs

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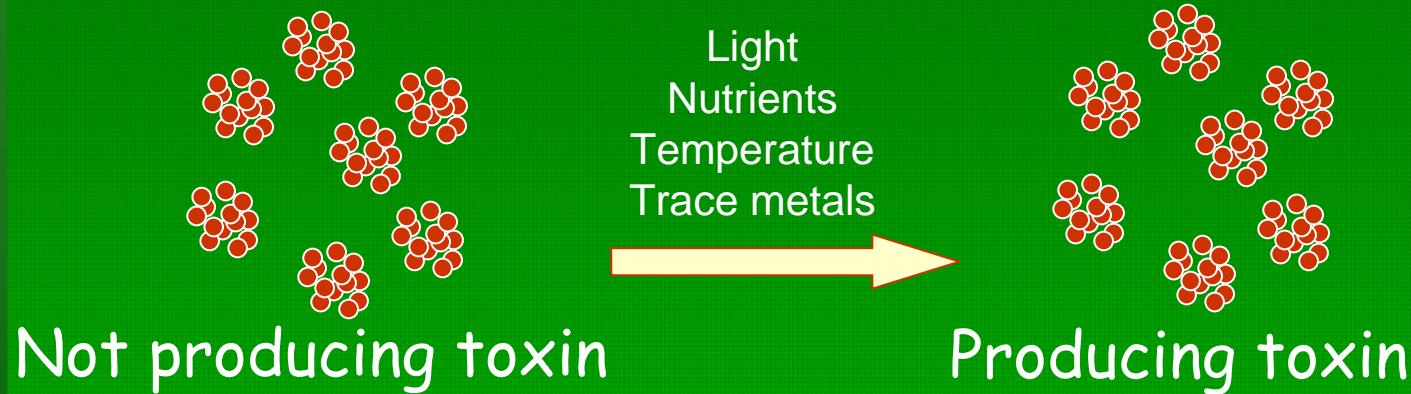
Michigan Sea Grant/ NOAA Center of
Excellence for Great Lakes and Human
Health

Toxins produced by freshwater planktonic cyanobacteria

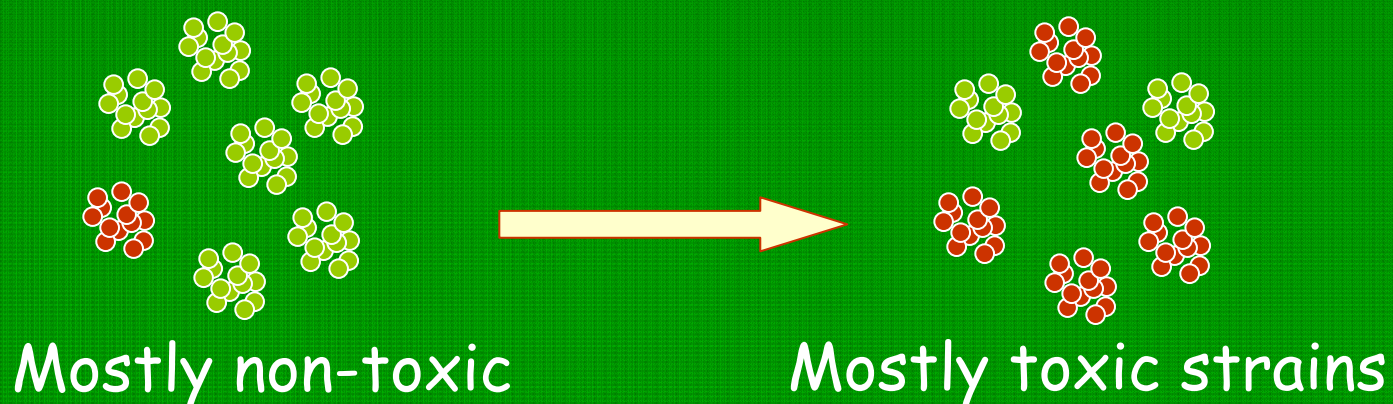
Toxin type	Primary organ affected	Produced by
microcystins	liver	<i>Microcystis</i> <i>Anabaena</i> <i>Oscillatoria</i>
anatoxins	nervous system	<i>Anabaena</i> <i>Aphanizomenon</i> <i>Oscillatoria</i>
saxitoxins	nervous system	<i>Anabaena</i> <i>Aphanizomenon</i> <i>Cylindrospermopsis</i>
cylindrospermopsins	liver	<i>Cylindrospermopsis</i> <i>Aphanizomenon</i>
LPS	skin irritant	all of the above

What makes a cyanobacterial bloom toxic?

- ❖ Stimulation of toxin production by environmental factors



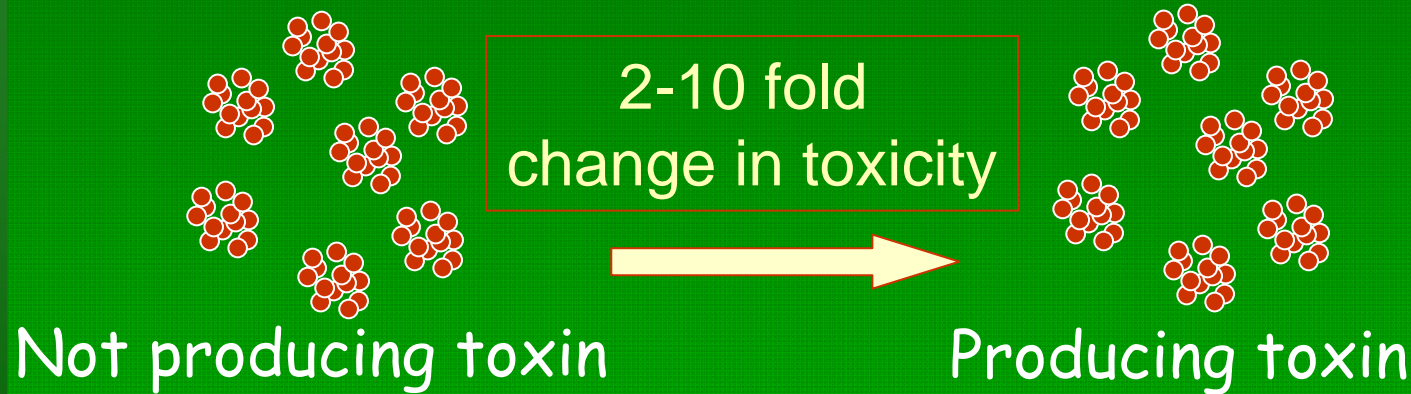
- ❖ Shift in community composition



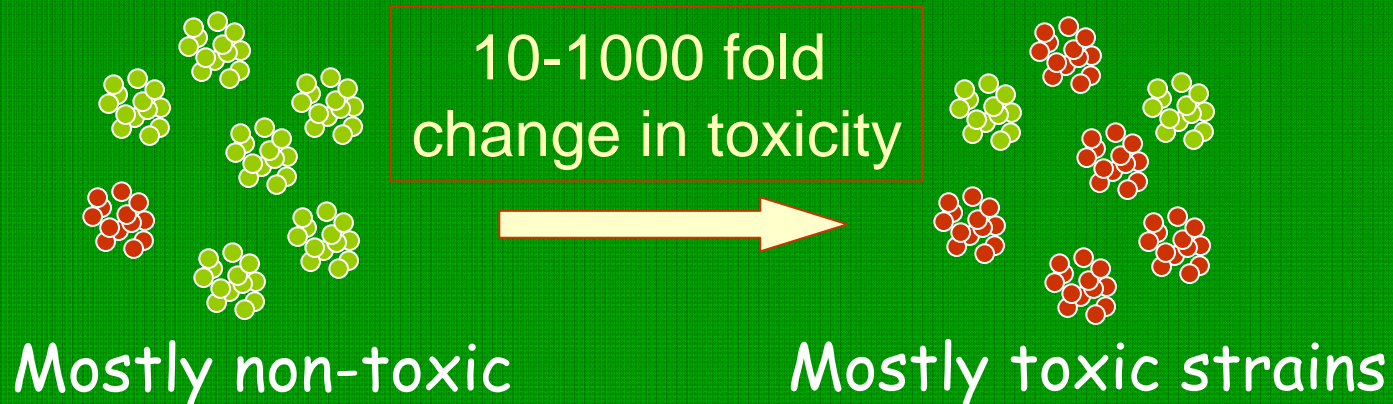
(Zurawell et al
2005)

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World Health Organization

- **Recommended Guidelines**

Drinking water = $1\mu\text{g/L}$

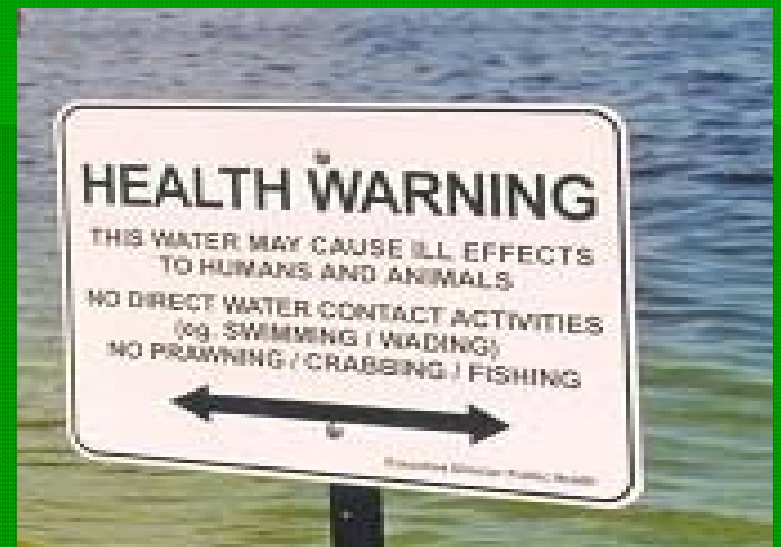
Low risk recreational = $2\text{-}4\mu\text{g/L}$

Moderate risk recreational - $20\mu\text{g/L}$

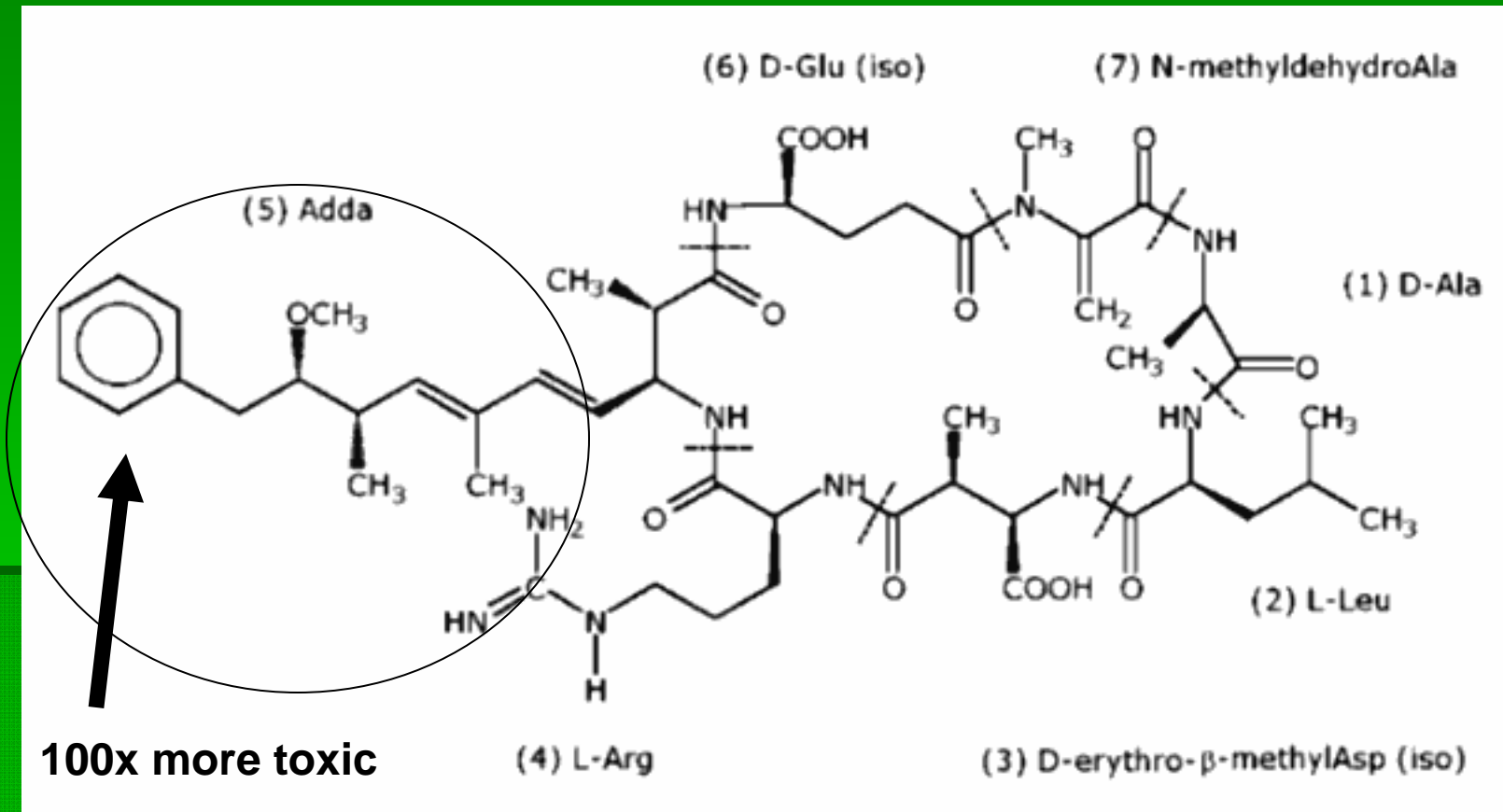
High risk recreational = avoid visible scums

Concerns about *Microcystis*

- ❖ Degrade water quality
 - Taste/odor issues; aesthetics; hypoxia
- ❖ Toxin production: hepatotoxin microcystin
 - Human health effects (OHH)
 - Ecosystem effects
 - ◆ reduced grazing
 - ◆ altered food web
 - ◆ bioaccumulation



Microcystin

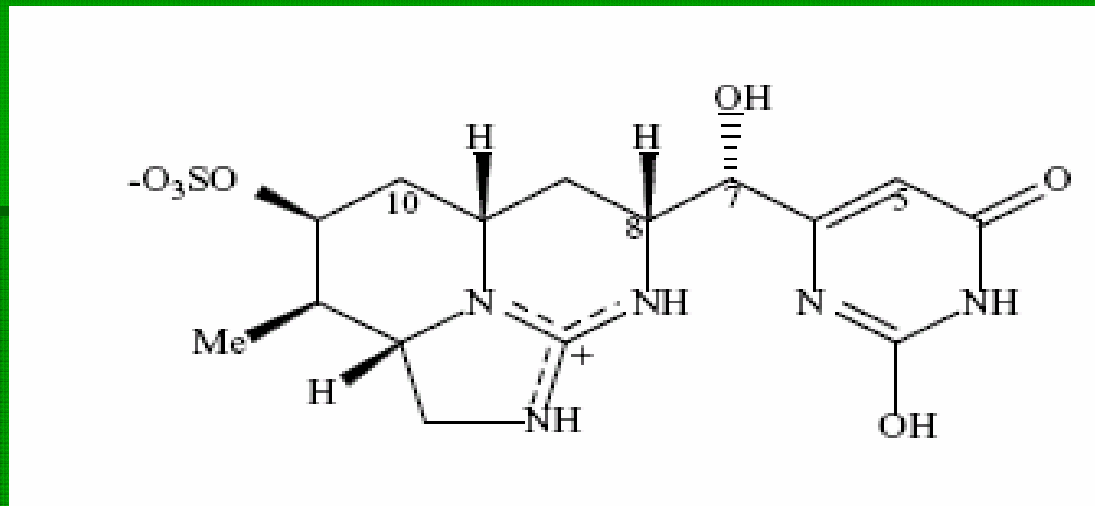


Microcystin Case Studies

- Brazil
 - 1988, gastro-enteritis epidemic over 2000 cases reported and 88 deaths.
 - *Anabaena* and *Microcystis* bloom.
 - 117 patients developed liver disease attributed to dialysis with microcystin-contaminated water, 50 deaths
- Rural Chinese populations infected with Hepatitis-B and drinking water contaminated with microcystins
 - Liver cancer link.

Cylindrospermopsis

- Now found in the Great Lakes
- Mainly hepatotoxin (liver)



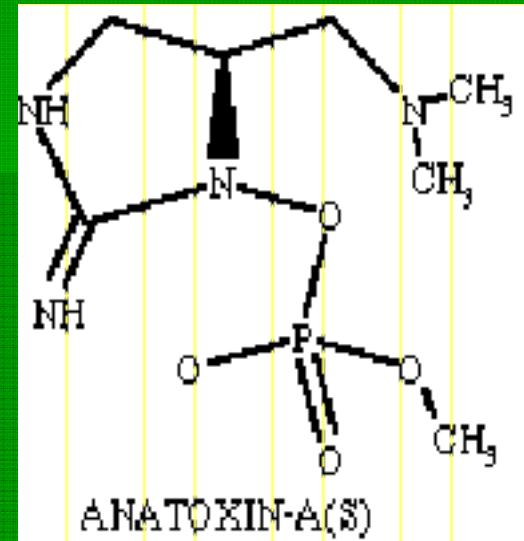
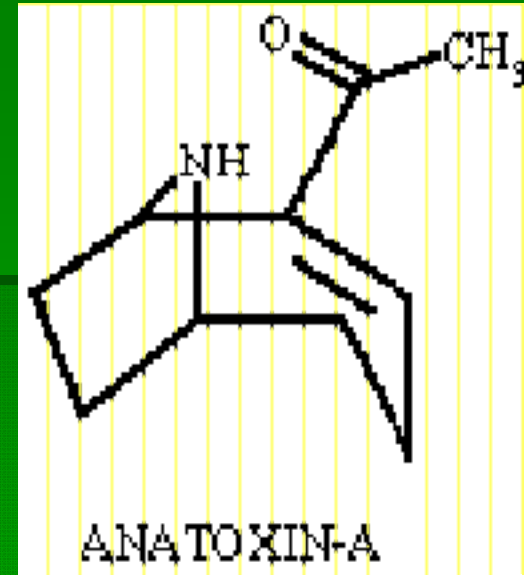
Palm Island Case Study

- Major bloom in Australian reservoir (1979)
- Drinking water chlorinated but not filtered
- Taste and odor complaints
- Treatment with copper sulfate
- Approx 150 complaints of malaise, anorexia, vomiting, headache and stomach pain.
- A culture of the reservoir water revealed the presence of *Cylindrospermopsis raciborskii*.

Health Effects of Anatoxins:

Anatoxin-a: sufficient exposure can lead to paralysis, asphyxiation and death; oral LD₅₀ (mice) ~ 5 ppm; repeated exposures to toxin caused fetal malformations and stunted growth in hamster litters; no maternal toxicity noted

Anatoxin-a(S): potent organophosphate produced by *A. flos-aquae*; this toxin blocks acetylcholinesterase activity; no oral toxicity studies could be found; symptoms include muscle weakness, respiratory distress and convulsions



Courtesy of Dr. David Stone, Oregon Dept of Health Services

Case study anatoxin-a

In July 2002, five teenagers went swimming in a pond at a golf course in Dane County, Wisconsin. The pond was described as “scummy” and “dirty.” The boys splashed around and two had their head submerged underwater.

Of the two who went underwater, one boy died of acute heart failure 48 hours later and the other became ill with acute diarrhea and abdominal pain. Blood tests on the boys confirmed the presence of *A. flos aquae* and anatoxin-a.

An algal toxin expert was quoted as saying the toxin was present in amounts that could cause symptoms & death based on animal studies, but was puzzled by the amount of time that had elapsed prior to death (Milwaukee Journal Sentinel, Sept. 5, 2003). Typically, neurological toxins act in minutes or hours versus days.

Courtesy of Dr. David Stone, Oregon Dept of Health Services