

Facts About
Cyanobacteria &
Cyanobacterial Harmful Algal Blooms

Department of Health and Human Services
Centers for Disease Control and Prevention
National Center for Environmental Health
Division of Environmental Hazards & Health Effects





Facts about Cyanobacteria (Blue-green Algae) and Cyanobacterial Harmful Algal Blooms (CyanoHABs)

Cyanobacteria (blue-green algae)

Cyanobacteria are bacteria that grow in water and are photosynthetic (use sunlight to create food and support life). Cyanobacteria live in terrestrial, fresh, brackish, or marine water. They usually are too small to be seen, but sometimes can form visible colonies. Cyanobacteria have been found among the oldest fossils on earth and are one of the largest groups of bacteria. Cyanobacteria have been linked to human and animal illnesses around the world, including North and South America, Africa, Australia, Europe, Scandinavia, and China.

Cyanobacterial blooms and how they form

Cyanobacterial blooms occur when algae that are normally present grow exuberantly. Within a few days, a bloom can cause clear water to become cloudy. The blooms usually float to the surface and can be many inches thick, especially near the shoreline. Cyanobacterial blooms can form in warm, slow-moving waters that are rich in nutrients such as fertilizer runoff or septic tank overflows. Blooms can occur at any time, but most often occur in late summer or early fall.

They can occur in marine, estuarine, and fresh waters, but the blooms of greatest concern are the ones that occur in fresh water, such as drinking water reservoirs or recreational waters.

What a cyanobacterial bloom looks like

Some cyanobacterial blooms can look like foam, scum, or mats on the surface of fresh water lakes and ponds. The blooms can be blue, bright green, brown, or red and may look like paint floating on the water. Some blooms may not affect the appearance of the water. As algae in a cyanobacterial bloom die, the water may smell bad.

Cyanobacterial harmful algal blooms (CyanoHABs)

CyanoHABs are algae blooms that threaten people, animals, or the environment. They are dangerous for many reasons:

- Dense CyanoHABs can block sunlight and use up all the oxygen in the water, killing other plants and animals.
- Some cyanobacteria that can form CyanoHABs produce toxins that are among the most powerful natural poisons known. These toxins have no known antidotes.
- CyanoHABs can make people, their pets, and other animals sick. Often, the first sign that an HAB exists is a sick dog that has been swimming in an algae-filled pond.
- Children are at higher risk than adults for illness from CyanoHABs because they weigh less and can get a relatively larger dose of toxin.

Other effects of fresh-water CyanoHABs

- CyanoHABs can make drinking water smell and taste bad.
- They can make recreational areas unpleasant.

Species of cyanobacteria that form CyanoHABs in fresh water

- *Microcystis aeruginosa*
- *Anabaena circinalis*
- *Anabaena flos-aquae*
- *Aphanizomenon flos-aquae*
- *Cylindrospermopsis raciborskii*

Cyanotoxins

Cyanotoxins are a diverse group of chemical substances that are categorized by their specific toxic effects as follows:

- Neurotoxins affect the nervous system.
 - Anatoxin-a
 - Anatoxin-a(s)
 - Saxitoxin
 - Neosaxitoxin
- Hepatotoxins affect the liver.
 - Microcystins
 - Nodularins
 - Cylindrospermopsin
- Tumor promoters are chemicals that can increase tumor growth.
 - Microcystins
- Lipopolysaccharides are chemicals that can affect the gastrointestinal system.

See the table below for a list of cyanotoxins and their specific toxic mechanisms, their effects, the symptoms they cause, and treatments for poisoning.

How you could be exposed to CyanoHABs and cyanotoxins

- Drinking water that comes from a lake or reservoir with a CyanoHAB.
- Drinking untreated water.
- Engaging in recreational activities in waters with CyanoHABs.
- Inhaling aerosols from water-related activities such as jet-skiing or boating.
- Inhaling aerosols when watering lawns, irrigating golf-courses, etc. with pond water.
- Using cyanobacteria-based dietary supplements that are contaminated with microcystins.
- Receiving dialysis (this has been documented only in Brazil).

Types of illnesses people and animals can get from exposure to CyanoHABs

- **Getting it on the skin** may give people a rash, hives, or skin blisters (especially on the lips and under swimsuits).
- **Inhaling water droplets** from irrigation or water-related recreational activities can cause runny eyes and nose, a sore throat, asthma-like symptoms, or allergic reactions.
- **Swallowing water** that has cyanobacterial toxins in it can cause
 - Acute, severe gastroenteritis (including diarrhea and vomiting).
 - Liver toxicity (i.e., increased serum levels of liver enzymes). Symptoms of liver poisoning may take hours or days to show up in people or animals. Symptoms include abdominal pain, diarrhea, and vomiting.
 - Kidney toxicity.
 - Neurotoxicity. These symptoms can appear within 15 to 20 minutes after exposure. In dogs, the neurotoxins can cause salivation and other neurologic symptoms, including weakness, staggering, difficulty breathing, convulsions, and death. People may have numb lips, tingling fingers and toes, or they may feel dizzy.

Testing for cyanobacterial toxins

- Most of the toxins require specialized testing that can take weeks.
- Some kits are available to test for microcystins on site.

How to protect yourself, your family, and your pets from exposure to CyanoHABs

- Don't swim, water ski, or boat in areas where the water is discolored or where you see foam, scum, or mats of algae on the water.
- If you do swim in water that might have a CyanoHAB, rinse off with fresh water as soon as possible.
- Don't let pets or livestock swim in or drink from areas where the water is discolored or where you see foam, scum, or mats of algae on the water.
- If pets (especially dogs) swim in scummy water, rinse them off immediately—do not let them lick the algae (and toxins) off their fur.
- Don't irrigate lawns or golf courses with pond water that looks scummy or smells bad.
- Report any "musty" smell or taste in your drinking water to your local water utility.
- Respect any water-body closures announced by local public health authorities.

How to treat people or animals that have been exposed to cyanobacterial toxins

- Get medical treatment right away if you think you, your pet, or your livestock might have been poisoned by cyanobacterial toxins.
- Remove people from exposure and give them supportive treatment.

How to help reduce the occurrence of CyanoHABs

- Reduce nutrient loading of local ponds and lakes by using only the recommended amounts of fertilizers and pesticides on your yard.
- Properly maintain your household septic system.
- Maintain a buffer of natural vegetation around ponds and lakes to filter incoming water.

How to get more information about cyanobacteria:

Federal

Centers for Disease Control and Prevention (CDC)

Harmful Algal Blooms (HABs) site

<http://www.cdc.gov/habs>

This site defines HABs; describes CDC's HABs-related activities; and provides links to data, publications, and other HABs resources.

Cyanobacteria site

<http://www.cdc.gov/hab/cyanobacteria/>

This site defines cyanobacteria; describes CDC's cyanobacteria-related activities; and provides links to data, publications, and other cyanobacteria resources.

Environmental Protection Agency (EPA)

Drinking Water Contaminant Candidate List Site

<http://www.epa.gov/safewater/ccl/cclfs.html>

This site provides information about EPA's list of contaminants that are not regulated,

occur in public water systems, and may require regulation under the Safe Drinking Water Act. Algae that can be harmful are on this list.

International

State of Queensland Australia

HAB site

http://www.nrm.qld.gov.au/water/blue_green/index.html

This site describes the state's plans and procedures for agency responding to HABs.

World Health Organization

Water Site

<http://www.who.int/topics/water/en/>

This site provides links to drinking and recreational water quality, including the impacts of cyanobacteria and cyanobacterial toxins.

States

North Carolina Department of Health and Human Services

Occupational and Environmental Epidemiology program, HABs Site

<http://www.epi.state.nc.us/epi/hab/>

This site gives an overview of North Carolina's HAB program and provides links to the state's HAB-related surveillance, research, and education activities.

Cyanobacterial toxins, effects, signs and symptoms of poisoning, and therapy

Toxin	Acute Effect	Signs and Symptoms	Therapy
Anatoxin-a	Neurotoxicity	<i>Humans:</i> not documented. <i>Animals:</i> progression of muscle fasciculations, decreased movement, abdominal breathing, cyanosis, convulsions, death. <i>Birds:</i> opisthotonos (“s”-shaped neck).	Supportive care. Respiratory support may allow time for detoxification and respiratory recovery.
Anatoxin-a (s)	Neurotoxicity	<i>Humans:</i> not documented. <i>Pigs:</i> hypersalivation, mucoid nasal discharge, tremors, fasciculations, ataxia, diarrhea, recumbency. <i>Ducks:</i> regurgitation, paresis, opisthotonos, clonic seizures. <i>Mice:</i> lacrimation, hypersalivation, urination, defecation, death from respiratory arrest. <i>Rats:</i> red-pigmented ears.	Supportive care.
Cylindrospermopsin	Hepatotoxicity, renal toxicity, chromosome breakage, aneuploidy	<i>Humans:</i> enlarged liver, malaise, anorexia, vomiting, headache. <i>Mice:</i> huddling, anorexia, slight diarrhea, gasping respiration.	Supportive care.
Microcystins	Hepatotoxicity	<i>Humans:</i> elevated gamma-glutamyl transpeptidase. <i>Humans, mice:</i> elevated alanine aminotransferase. <i>Rats:</i> embryo lethality, teratogenicity. <i>Mammals:</i> weakness, reluctance to move, anorexia, pallor of extremities and mucous membranes, mental derangement, survivors may be photosensitized.	<i>Humans:</i> powdered charcoal, supportive care. <i>Animals:</i> cholestyramine.
Nodularin	Hepatotoxicity	<i>Humans:</i> Skin and eye irritation from skin contact. <i>Experimental systems:</i> inhibition of protein phosphatases, tumor-promoter.	Supportive care.
Saxitoxin, neosaxitoxin	Neurotoxicity	<i>Humans:</i> paresthesia and numbness of lips and mouth within ½ to 3 hours after exposure, extending to face, neck, extremities; motor weakness; incoordination; respiratory and muscular paralysis. <i>Animals:</i> incoordination, death by respiratory failure.	Activated charcoal, artificial respiration. Supportive care.

References:

Carmichael WW, Beasley V, Bunner DL, Eloff JN, Falconer IR, Gorham PR, et al. Naming of cyclic heptapeptide toxins of cyanobacteria (blue-green algae). *Toxicon*. 1988;26:971-3.

Carmichael, WW, Falconer IR. Diseases related to freshwater blue-green algal toxins, and control measures. P. 187-209. In: Falconer I R (ed.). *Algal Toxins in Seafood and Drinking Water*. London: Academic Press. 1993: pp187-209.

Dahlem AM, Hassan AS, Swanson SP, Carmichael WW, Beasley VR. A model system for studying the bioavailability of intestinally administered microcystin-LR, a hepatotoxic peptide from the cyanobacterium *Microcystis aeruginosa*. *Pharmacol. Toxicol.* 1989;64:177-81.

Falconer, IR, Beresford AM, Runnegar MT. 1983. Evidence of liver damage by toxin from a bloom of blue-green algae, *Microcystis aeruginosa*. *Med J Aust.* 1983;1: 511-4.

Hawkins PR, Chandrasena NR, Jones GJ, Humpage AR, Falconer IR. Isolation and toxicity of *Cylindrospermopsis raciborskii* from an ornamental lake. *Toxicon*. 1997;35:341-346.

Humpage A R, Hardy SJ, Moore EJ, Froschio SM, Falconer IR. Microcystins (cyanobacterial toxins) in drinking water enhance the growth of aberrant crypt foci in the mouse colon. *J Toxicol Environ Health, Part A.* 2000;61:155-65.

Kirpenko YA, Sirenko LA, Kirpenko NI. Some aspects concerning remote after-effects of blue-green algal toxin impact on warm-blooded animals. In: Carmichael WW (ed.). *The Water Environment, Algal Toxins and Health*. New York: Plenum, 1981: pp257-69.

Soong F S, Maynard E, Kirke K, Luke C. Illness associated with blue-green algae. *Med J Aust.* 1992;156:67.

Turner PC, Gammie AJ, Hollinrake K, Codd GA (1990). Pneumonia associated with contact with cyanobacteria. *Br Med J.* 1990;300:1440-1.