Are Cyanobacteria (“blue-green algae”) toxic?

What are cyanobacteria (“blue-green algae”)?
Cyanobacteria, often referred to as “blue-green algae,” are a group of microscopic bacteria that are photosynthetic (can make some of their own nutrients using energy from light). They can exist as single cells or groups of cells.

Why do we need to know about cyanobacteria?
Some species of cyanobacteria are capable of producing toxins or irritants that can cause illness and even death in animals and humans. The vast amount of available information on health effects relates to animals, which typically have much higher exposures to cyanobacteria.

What are cyanotoxins?
Cyanotoxins are chemicals produced by cyanobacteria that can cause harmful effects. Depending on the toxin, acute (immediate) health effects vary and can include injury to the liver, nervous system, kidneys or skin irritation.

Where do cyanobacteria occur? 
Cyanobacteria occur in a wide range of fresh and salt water environments throughout the world. They tend to flourish and bloom in relatively undisturbed bodies of water that are rich in nutrients with optimal light and warm water conditions.

What do cyanobacteria look like? 
Individual cyanobacteria are not visible to the naked eye, but groups of cells may appear as green or greenish-blue turbid “pea soup” areas of water, oily appearing films on the water surface, or filamentous strands. Heavy blooms result in foamy-appearing mats on the water surface. Filamentous forms of cyanobacteria should not be confused with true algae or water weeds.
Examples of cyanobacteria accumulations:

Example of water weeds, which are different from cyanobacteria:

Water Weeds (which are not cyanobacteria)
**How can cyanobacteria make people or animals sick?**

Only some types of cyanobacteria produce toxins, and the health effects of the toxins vary according to type. A wide range of health effects is possible, but occur only when the causative toxin is present at elevated levels and an animal or person is exposed to it. Effects can include liver damage, kidney damage, neurological effects, or skin irritation. In addition, a wide range of nonspecific symptoms, such as gastrointestinal upset, headache, flu-like symptoms, and eye/ear irritation, may occur. Some cyanotoxins may promote growth of existing tumors. Scientists are still studying how and at what levels cyanotoxins affect people’s health.

**Do all cyanobacteria make people sick?** No. Only some cyanobacteria are capable of producing toxins and they do not necessarily release them all the time.

**How is illness caused by cyanobacteria diagnosed?**

There are no medical tests that identify cyanotoxins in people or easily prove that an illness is related to exposure to toxic cyanobacteria. Research studies make the connection by testing for toxins in the source of exposure (e.g., the water) and in the body of the exposed animal, including the stomach contents and affected internal organs, such as the liver and kidneys. As a practical matter, when people are concerned about illness, their doctor will collect information about their symptoms and the timing and nature of cyanobacteria exposure. Blood samples may be helpful in evaluating patients, but they do not directly check for cyanotoxins. The physician will also look for other possible causes of the illness and will make a determination as to the most probable cause.

**How many cyanotoxins are there?**

There are an enormous number of cyanotoxins, and not all toxins have yet been identified in this emerging field of science. There are more than 80 distinct, but related toxins in one category alone. Most research and attention focus on a small subset of toxins considered to be the most potent and likely to be associated with harmful effects.

**How are people exposed to cyanotoxins?**

Illness caused by cyanotoxins does not occur without exposure. Exposure requires direct contact in some form with the toxin, including drinking or eating (e.g., fish), inhaling aerosol, or contact with the skin. Simply being present in the general area of cyanobacteria does not mean that exposure has occurred.

**What should I do if I come into contact with lake water in areas of algal blooms?**

You should promptly use a towel to dry off and shower in clean water as soon as possible. If shower facilities are not readily available, rinsing off with clean water may be helpful as an interim measure.

**Are some people or animals more likely to get sick than others?**

The vast majority of reported illnesses and deaths related to cyanobacteria exposures have occurred in pets and livestock. Children are considered to be at greater risk of harmful effects than adults. People with underlying diseases (such as liver disease) that
could be aggravated by a specific toxin may be at higher risk than average. Some sensitive individuals with asthma and related conditions could experience worsening of their symptoms due to the bad odors (not cyanotoxins) given off by decaying algal mats.

**What should I do if I think I am sick because of cyanobacteria?**
See your doctor. Tell your doctor about when and how you were exposed. Encourage your doctor to call Lake County Public Health to report your illness if there is a strong suspicion that it is related to cyanobacteria exposure.

**How can I know if the water is safe for swimming, boating or other recreation?**
The most important safeguard is to learn to recognize the presence of cyanobacteria blooms. If you see it, avoid direct contact with the affected water and leave a margin of safety of 50-100 feet away from the affected areas. As a good general practice, even if the water appears clear, it is always advisable to avoid swallowing it while swimming, towel off promptly, and shower as soon as practical after swimming or being exposed to spray. Children should be told to avoid swallowing the water when playing or wading in shallow areas.

Example of “*pea soup*” appearance of cyanobacteria

Example of *oily surface* appearance of cyanobacteria
Examples of *thick mat* appearance of cyanobacteria

**Are health advisories posted?**
Lake County Environmental Health posts Health Advisory signs in areas where cyanobacterial blooms occur regularly, severely, or persistently. However conditions in Clear Lake are often rapidly changeable, so a good rule of thumb for cyanobacteria is “if you see it, stay away from it.”
How often is the water checked for cyanotoxins?
Through a variety of efforts, testing for several types of cyanotoxins in Clear Lake takes place approximately quarterly. Most testing falls within the realm of research, and it is not possible to test for all toxins. While there are currently no requirements for cyanotoxin testing, there is ongoing interest in developing affordable and reliable methods to better understand and monitor the changing patterns of cyanobacterial growth in Clear Lake.

Are there official “safe” levels of cyanotoxins?
There are currently no California or federal guidelines for cyanotoxins in water. The determination of “safe” levels of exposure to cyanotoxins remains a subject of research, which is looking at health effects from both short-term and long-term exposures. The World Health Organization (WHO) developed a provisional drinking water guideline for only one type of cyanotoxin: 1 microgram/liter (L) microcystin-LR. However, experts point out that the health effects from exposures to one or more types of cyanobacteria in recreational waters cannot be precisely defined or predicted.

Is testing of lake water for cyanotoxins required?
Testing for cyanotoxins in Clear Lake is not required by any regulatory agencies, but is being done for research purposes and to assist local authorities in understanding the characteristics of the lake and how it may impact local residents, tourists, and businesses. As the largest natural lake in California, Clear Lake is too big (68 square miles) and changeable in its conditions to allow for “real time” testing in all locations. To date, nearly all toxin measurements have been non-detectable or low. Measurements of untreated water in isolated areas of heavy bloom have rarely exceeded the WHO’s guidance level of 8-10 micrograms/L for microcystin in recreational waters.

Is it safe to drink water from Clear Lake?
Using untreated lake water for drinking, dishwashing or bathing is never considered safe, even if cyanobacteria are not present. Some cyanotoxins resist boiling, so boiling water cannot be considered an effective form of water treatment. Local water districts apply various methods of water treatment that have been demonstrated to effectively remove some cyanobacteria and their toxins. Some water districts test for cyanotoxins even though they are not required to do so. In California, there are no drinking water standards specifically for cyanotoxins, but the Environmental Protection Agency’s “Contaminant Candidate List” now includes cyanobacteria and their toxins for prioritization and consideration for future regulation. The World Health Organization has established a provisional drinking water guideline of 1 microgram per liter of total microcystin-LR. Testing of representative drinking water systems drawing from Clear Lake in 2011 during a period of a heavy cyanobacteria bloom demonstrated that no microcystin was detectable in “finished” water (after treatment), even though it was present in some instances prior to treatment.
How can I know if the water is safe for swimming, boating or other recreation?
As a good general practice, avoid jet-skiing, windsurfing, or water-skiing over scum or visible blooms in order to minimize exposure to cyanotoxins that may be present.

How can I protect my dog from cyanotoxins?
Do not allow dogs to drink lake water or swim in lake water that is suspected of having a cyanobacteria bloom. Do not allow dogs to eat crusts or mats of cyanobacteria that have washed up and dried at the lake edge or on the beach. If you suspect your dog has been in contact with a cyanobacterial bloom, wash it thoroughly with clean water to prevent ingestion of cyanobacteria or toxins when your pet cleans itself. If you take your pet to a local veterinarian, ask the veterinarian to report any illness relating to cyanobacteria exposure to Lake County Public Health (707-263-1090).

What is the history of cyanobacteria in Clear Lake?
Cyanobacteria are not new to Clear Lake. They are some of the oldest organisms on earth and are present in fresh- and salt-water bodies throughout the world. Historical accounts of Clear Lake from the 19th century have described mats on the water surface similar to what can be seen today. The bloom cycles over many years create a waxing and waning of the severity of the phenomenon. As people increasingly live and recreate near the lake, the impact of the heavy blooms is felt more acutely. Over time and with many factors at work, the balance of cyanobacteria species shifts and changes. Many of the factors that influence bloom occurrence and whether toxins are produced during a bloom are not well understood, but include amount of daylight, as well as water temperature and nutrient content.

What can we do to lessen harmful algal blooms?
Reduce nutrient loading of local ponds and lakes by using only the recommended amounts of fertilizers and pesticides on your yard. Make sure your land is not eroding into a water source that ends up in the lake. Don’t dump trash, debris or yard waste into creeks, tributaries or storm drains. Properly maintain your household septic system. Maintain a buffer of natural vegetation around Clear Lake to filter incoming water. It is illegal in Lake County to remove or kill tules except under certain circumstances that require a permit.
Can we predict cyanobacteria blooms?
No. Scientific knowledge of the many cyanobacteria inhabiting Clear Lake is not
detailed enough to predict blooms.

Can the cyanobacteria be removed?
For nearly half a century, residents of Lake County have sought ways to “clean up” Clear
Lake. None of these efforts have had dramatic effects and some of them can produce
unintended consequences, such as speeding the release of cyanotoxins into the lake water.
The Lake County Department of Water Resources is exploring methods for harvesting
and using the biomass resulting from cyanobacteria. Because of the very large size of
Clear Lake, removal of the cyanobacteria on a large scale is not practical, though it may
be possible to target localized collections that are a nuisance.

Can’t we poison the cyanobacteria?
Use of chemicals to destroy the cyanobacteria is strongly discouraged, as chemicals can
lead to release of toxins into the water and may be undesirable additions to the
ecosystem.

Why do the cyanobacterial accumulations smell so bad?
Cyanobacterial accumulations are buoyant and float to the water’s surface, where they
decompose. In the process, the decaying mats release hydrogen sulfide, which produces
a noxious “rotten egg” or “sewage” odor that can be detected by the nose at very low
levels. Although the amounts of hydrogen sulfide released into the air are not likely to
ever reach toxic levels, even very low levels may trigger asthma in some sensitive people.
Other gases, such as ammonia and mercaptens (related to some of the chemicals in skunk
spray), may contribute to the bad smell.
Is research on cyanobacteria being done?
Cyanobacteria are being studied all over the world, including Clear Lake. There is still much to be learned about the wide array of cyanobacteria and the toxins that they may produce. Tests for the majority of possible toxins are still not readily available, so most available information concentrates on the cyanobacteria and toxins considered to be the most likely to be harmful.

Health Surveillance
It is difficult to prove that illness in an individual is related to exposure to cyanobacteria. Even so, Lake County Public Health is asking local physicians and veterinarians to report cases of illness that they suspect are linked to recent cyanobacteria exposure. Conditions can range from liver disease to skin rashes, to neurologic conditions – all of which can result from many other causes. Self-diagnosis does not take the place of diagnostic evaluation by a trained health provider. Since 2009, in Lake County only one physician-reported case of skin rash has raised suspicion for a possible link to cyanobacteria exposure. Whether there is a causal relationship of cyanotoxin exposure to cancer is not clear, but remains a subject of research.