

# Utah Guidance for Local Health Departments

## Harmful Algal Blooms and Human Health



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As summer approaches and the weather gets warmer, conditions become more favorable for the growth of potentially harmful blue-green algae in Utah's lakes, ponds, and streams. Blue-green algae blooms in Utah have caused livestock deaths and were suspected of causing human illnesses in the past. Harmful algal blooms are caused by organisms known as cyanobacteria. Though calling them algae is technically inaccurate, this guidance uses the commonly used names "harmful algae" or "blue-green algae."

In 2014, algal blooms resulted in public notifications due to concerns for human health. In response to inquiries from local health department officials, the Utah Department of Health (UDOH) and the Utah Department of Environmental Quality (UDEQ) have reviewed the available literature on health risks associated with blue-green algae and have developed the following harmful algal bloom guidance for local health departments (LHDs). This guidance is designed to assist recreational water decision-making for LHDs, particularly when public notifications and beach closures, may be warranted.



It is important to remember that no one should ingest untreated lake or pond water at any time. All untreated surface waters contain bacteria, algae, viruses, and numerous other pathogens. Consuming untreated water sources may pose serious health risks to humans, pets, and livestock.

### **Sampling of Utah Water Bodies**

While blue-green algae are not new to Utah, UDEQ is increasing its sampling efforts in selected Utah lakes to determine the prevalence of blue-green algae such as *Anabaena*, *Microcystis*, and *Cylindrospermopsis* species. UDEQ regularly collects algal samples from lakes to assess the effects of nutrients in the water and characterize the ecology.

Health officials, natural resources specialists, and the public should become as well-informed as possible regarding the public health issues presented by harmful algal blooms. Local health officials particularly should seek good information to assist them in interpreting sampling results and taking appropriate public health actions. This guidance will assist local health officials and natural resource specialists in using blue-green algae sampling and other indicators of potential harmful algal blooms to make appropriate decisions regarding recreational use of lakes in Utah.

### **Background on Blue-Green Algae**

Blue-green algae are photosynthetic single-celled aquatic organisms that tend to be found living near the surface of lakes or ponds. Their relative abundance in a lake is dependent on a variety of factors such as water temperature and available nutrients. Many types of blue-green algae, and some non-toxic algae, can form visible scums or large floating mats on lake surfaces during an algal bloom. It is important to keep in mind that some species of blue-green algae don't form surface scums, nor do all species of blue-green algae produce toxins.

The concentration of blue-green algae and their toxins can change dramatically on a lake from one

location to another and from one day to another. Blooms can cover an entire lake or only isolated areas. When conditions are calm, blue-green algae blooms typically occur or disperse in the time frame of a few days. It is important to note that algal toxins can linger for days after the bloom is no longer visible; also, depending on the type of blue-green algae present, the toxin concentrations in a lake may even increase soon after a bloom disappears. This is due to toxins trapped inside the algae being released to the water when the algae cells die. These factors make it challenging to determine when and what type of public health action is appropriate to address a developing algal bloom.

**Health Concerns Associated with Blue-Green Algae**

When present in high numbers in recreational waters, blue-green algae can cause eye, ear, and skin irritation. Gastrointestinal symptoms such as vomiting and diarrhea can also result from exposures to blue-green algae. Animals such as dogs and cattle may become sick from eating the blue-green algae surface scum.

Blue-green algae toxins can be classified into two major types: neurotoxins and hepatotoxins. Neurotoxins affect the nervous system; blue-green algae neurotoxins include anatoxin-a, anatoxin-a(s) and saxitoxin. These are commonly produced by the *Anabaena* and *Oscillatoria* species. Animals or humans ingesting these toxins may develop muscle cramps, twitching, paralysis and cardiac or respiratory failure. Symptoms can occur within an hour of exposure, but may take as long as 36 hours to develop.

Hepatotoxins affect the liver; common blue-green algae hepatotoxins include microcystin and cylindrospermopsin. These toxins are produced by the *Microcystis* and *Cylindrospermopsis* species, respectively. These toxins cause symptoms such as nausea, vomiting, and acute liver failure. In general, symptoms will appear rapidly following exposure to high amounts of hepatotoxins, but may take several days in the case of more moderate exposures exposure.

Though the most serious health effect of harmful algal blooms is due to exposure to cyanotoxins, skin rashes can also result from contact with blue-green algae alone.

**Table 1. Common Cyanotoxins Expected in Utah<sup>1</sup>**

Toxin Type	Genera	Toxins	Symptoms of Exposure
Neurotoxin	<i>Anabaena</i> ; <i>Oscillatoria</i>	Anatoxin-a; anatoxin-a(s); saxitoxin	Muscle cramps; twitching; paralysis; cardiac or respiratory failure; death in animals
Hepatotoxin	<i>Microcystis</i> ; <i>Cylindrospermopsis</i>	Microcystin; cylindrospermopsin	Nausea; vomiting; acute liver failure

<sup>1</sup> Nodularin has been detected in Great Salt Lake but the toxicity data are currently inadequate to make recommendations.

**Existing Guidance Regarding Blue-Green Algae**

To date, neither the U.S. Environmental Protection Agency (EPA) nor the U.S. Centers for Disease Control and Prevention have issued official regulatory or health-based standards for safe levels of blue-green algae or toxins in recreational waters or drinking water. The EPA is expected to issue drinking

water guidelines for certain cyanotoxins in 2015. EPA expects to include guidance for recreational waters in 2016. In the absence of U.S. national standards, the UDOH and UDEQ have provisionally adopted blue-green algae health guidelines based upon those outlined by the World Health Organization (WHO).

WHO guidelines state:

- A **very low** probability for adverse health effects are expected when blue-green algae cell counts are less than 20,000 cells per milliliter (cells/mL). No actions are necessary at this level.
- A **low** probability for adverse health effects is expected when blue-green algae cell counts are between 20,000 and 100,000 cells/mL. At this level, providing information to bathers is considered sufficient.
- A **moderate** probability for adverse health effects is expected when blue-green algae cell counts are between 100,000 and 10,000,000 cells/mL. Interventions such as restricting bathing at beaches and public education campaigns may be appropriate when blue-green algae counts are at this level.
- A **high** probability for adverse health effects is expected when blue-green algae cell counts are greater than 10,000,000 cells/mL, or there are blue-green algae scums at bathing areas. The WHO reports that animal poisonings and human illnesses related to blue-green algae are usually accompanied by the presence of scum material at the water surface, and that ongoing observation of bathing beaches is necessary to assess the existence of high-risk exposures. Interventions such as restricting bathing at beaches and public education campaigns may be appropriate when blue-green algae counts are at this level.

Many blue-green algal species of concern form clumps, spheres, and/or coils of intertwined cells. Therefore, it is often problematic to quantify cell counts using routine laboratory protocols. It may not be possible in some cases to compare cell densities from any particular lake or pond sample to the guidelines provided by the WHO regarding human risk from exposure to blue-green algae.

Because certain species, such as those within *Cylindrospermopsis*, are not prone to form surface scums when cell counts are high, the WHO guidance for defining high levels of risk is less informative for these species than for others. It is also likely that there is some variation in the degree to which different species of blue-green algae contribute to skin rashes.

**Table 2. WHO Guidelines for Blue-Green Algae Density in Recreational Water**

Relative Probability of Acute Health Risk	Blue-green algae Cell Density (cells/mL)	Health Risks	Action Recommended
Very Low	<20,000	Negligible	None
Low	20,000-100,000	Short-term effects e.g. skin irritation, gastrointestinal illness	Post risk advisory
Moderate	100,000-10,000,000	As above for low risk, and potential for long-term illness	Post risk advisory & possible closure
High	>10,000,000 or Visible scum layer	As above for moderate risk, and potential for acute poisoning	Closure

**Posting Health Advisories and/or Beach Closures**

*Authority*

- A local health department may prepare, publish, and disseminate information necessary to inform and advise the public concerning the health and wellness of the population, specific hazards, and risk factors that adversely affect the health and wellness of the population. [UAC, 26A-1-114, (1)(i)(i)]
- A local health department may close theatres, schools, and other public places and prohibit gatherings of people when necessary to protect public health. [UAC, 26A-1-114 (1)(e)]

*Guidance*

The UDOH and UDEQ recommend that local health departments use Table 3 and the decision algorithm outlined in Appendix A, Figure A-1 when determining the appropriate level of health risk and public health action for a given water body. In the algorithm, **red arrows** indicate increasing potential hazard of harmful algal blooms; **blue arrows** indicate decreasing hazard. As shown in Table 3 and the algorithm, if an LHD receives reports of human or animal illness or death that is plausibly linked to blue-green algae, an immediate public health advisory is recommended. Once an advisory is issued, at least 2 weeks of measurements that indicate that the hazard has passed are recommended before removing the advisory.

The relationship between the cell counts shown in Table 3 and other potential measures (such as toxin concentrations) that are used to assess hazardous algal blooms are shown in

Appendix A, Table A-1. In some situations, results for several of these measures may be available. Without any additional site-specific information, the highest level of public health advisory supported by any of the different measures shown in Table A-1 is recommended in order to be as protective of public health as possible

Examples of CAUTION, WARNING and DANGER signs are also included in Appendix A (Figures A-2, A-3, and A-4).

**Table 3. UDOH/UDEQ Harmful Algal Bloom Decision Guidelines (WHO, 1999).**

Relative Probability of Acute Health Risk	Toxin Producing Blue-green algae Cell Density (cells/mL)	Health Risks	Action Recommended
Very Low	<20,000	Negligible	None
Low	20,000-100,000	Short-term effects e.g. skin irritation, gastrointestinal illness	Issue caution advisory; Post <b>CAUTION</b> sign;  Weekly sampling recommended
Moderate	100,000 – 10,000,00 or reports of animal illnesses or death	As above for low risk, and potential for long-term illness	Issue warning advisory; Post <b>WARNING</b> sign;  Weekly sampling recommended
High	>10,000,000 or large scum mat layer or reports of human illness;	As above for moderate risk, and potential for acute poisoning	Issue Danger Advisory; Post <b>DANGER</b> sign;  Weekly sampling recommended  Consider <b>Closure</b>

**Guidance for Water Body Sampling**

The recommended standard operating procedure (SOP) for collecting samples for HABs and HAB toxins are described in the Division of Water Quality’s *Standard Operating Procedure for collection of Phytoplankton Samples During Harmful Algal Blooms*.

**Communication with the Public**

UDOH has developed a fact sheet for the general public on blue-green algae, the toxins they produce and their health effects. LHD officials are encouraged to use this fact sheet as part of their education and outreach efforts to the community. The fact sheet is included in Appendix B.

### **Fish Consumption from High Blue-Green Algae Count Areas**

Some studies have shown that cyanotoxins can accumulate in fish to some degree in natural waters with high toxin levels. It is known that the body concentrations of cyanotoxins in fish are greatest in organs and fatty adipose tissue, with the lowest concentrations found in the muscle tissue (Zhang et al, 2009). While there have been no confirmed reports of cyanotoxin-related human health effects related to fish consumption, there are few data on cyanotoxins in lakes, fish, or shellfish to adequately base judgments regarding this health risk.

UDOH and UDEQ recommend careful cleaning and thorough cooking of fish harvested from waters where blue-green algae are present. This includes removing skin and fatty deposits from the fish and ensuring that the meat is well-rinsed before cooking.

More information:

Brient, L. et al. 2008. A phycocyanin probe as a tool for monitoring cyanobacteria in freshwater bodies. *J. Environ. Monit.* 10(2):248-255

Zhang D, Xie P, Liu Y, Qiu T, 2009. Transfer, distribution and bioaccumulation of microcystins in the aquatic food web in Lake Taihu, China, with potential risks to human health. *The Science of the Total Environment* [2009, 407(7):2191-2199]

Graham, J.L., Loftin, K.A., Ziegler, A.C., and Meyer, M.T., 2008, Blue-green algae in lakes and reservoirs—Toxin and taste-and-odor sampling guidelines (ver. 1.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A7, section 7.5, September, available online only from <http://pubs.water.usgs.gov/twri9A/>.

[Interagency, International Symposium on Blue-green algae Harmful Algal Blooms](#)

[US EPA Contaminant Candidate List \(CCL\) and Regulatory Determinations](#)

[US EPA Creating a Cyanotoxin Target List for the UCMR \(PDF\) \(17 pp, 110K; About PDF\)](#)

[WHO Blue-green algae toxins: Microcystin-LR in Drinking-water](#)

[WHO \(1999\) Toxic blue-green algae in water: A guide to their public health consequences, monitoring and management](#)

[WHO Guidelines for Safe Recreational Waters Volume 1 - Coastal and Fresh Waters](#)

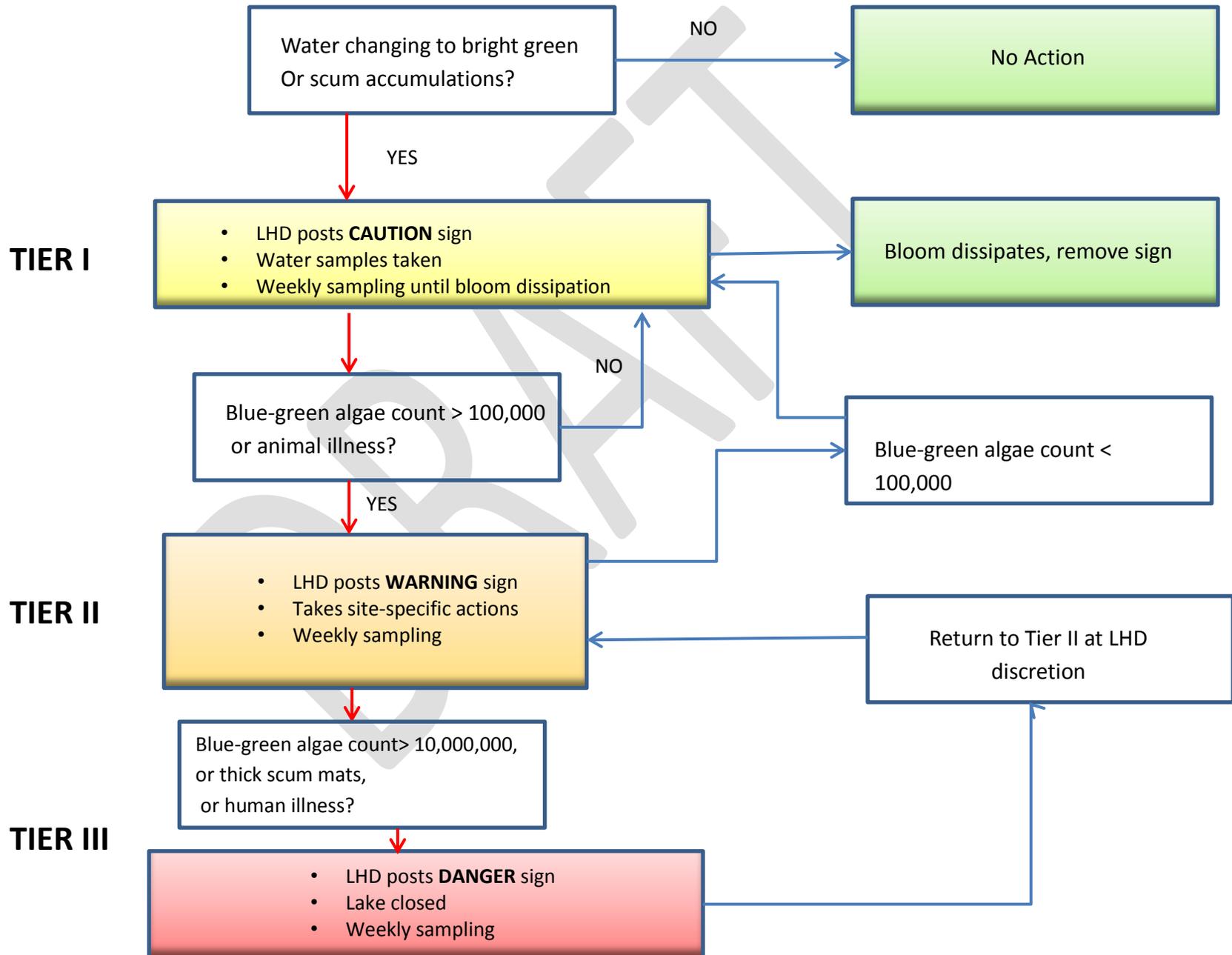
Prepared by the Utah Department of Health, Division of Disease Control and Prevention, Environmental Epidemiology Program with funds from the Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services and the Utah Division of Water Quality

## **Appendix A**

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APPENDIX A

Figure A-1. Decision-making algorithm tool.



**Table A-1. Comparison of Cell Counts to Other Measurements of Harmful Algal Blooms from WHO (1999).**

Relative Probability of Acute Health Risk	Toxin Producing Blue-green algae Cell Density (cells/mL)	Microcystin Concentrations (µg/L)	Anatoxin-A <sup>1</sup> (µg/L)	Chlorophyll <i>a</i> (µg/L)	Health Risks	Action Recommended
Very Low	<20,000	<4	<20	<10	Negligible	None
Low	20,000-100,000	4-20	>20	10-50	Short-term effects e.g. skin irritation, gastrointestinal illness	Issue caution advisory; Post <b>CAUTION</b> sign;  Weekly sampling recommended
Moderate	100,000 – 10,000,00 or Reports of animal illnesses or death	20-2,000		50-5,000	As above for low risk, and potential for long-term illness	Issue warning advisory; Post <b>WARNING</b> sign;  Weekly sampling recommended
High	>10,000,000 or Visible scum layer or Reports of human illness	>2,000	NA	>5,000	As above for moderate risk, and potential for acute poisoning	Issue Danger Advisory; Post <b>DANGER</b> sign;  Weekly sampling recommended  Consider <b>Closure</b>

Notes:

<sup>1</sup> From [Oregon Public Health Advisory Guidelines](#)

NA = None available

Figure A-2. Example Caution Sign

# CAUTION

## TOXIC ALGAE MAY BE PRESENT

Lake may be unsafe for people and pets

**Until further notice:**

- **Do not swim or water ski in areas of scum.**  
No nade o practique el esquí acuático en áreas con espuma o verdín.
- **Do not drink lake water.**  
No tome el agua del lago.
- **Keep pets and livestock away.**  
Mantenga alejados las mascotas y el ganado.
- **Clean fish well and discard guts.**  
Limpie bien el pescado y deseche las tripas.
- **Avoid areas of scum when boating.**  
Evite las áreas con espuma o verdín cuando ande en lancha.



**Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.**

Report new algae blooms to the Department of Environmental Quality:	Call your local health department:
<input type="text"/>	<input type="text"/>



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UTAH DEPARTMENT OF HEALTH

Figure A-3. Example Warning Sign

# WARNING

## TOXIC ALGAE PRESENT

Lake unsafe for people and pets

**Until further notice:**

- **Do not swim or water ski.**  
No nade o practique el esquí acuático.
- **Do not drink lake water.**  
No tome el agua del lago.
- **Keep pets and livestock away.**  
Mantenga alejados las mascotas y el ganado.
- **Clean fish well and discard guts.**  
Limpie bien el pescado y deseche las tripas.
- **Avoid areas of scum when boating.**  
Evite las áreas con espuma o verdín cuando ande en lancha.



**Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.**

Report new algae blooms to the Department of Environmental Quality:	Call your local health department:
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Figure A-4. Example Danger Sign

**DANGER**

**LAKE CLOSED**  
due to toxic algae

**KEEP OUT  
OF LAKE**

Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.

Report new algae blooms to the Department of Environmental Quality:	Call your local health department:
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**Appendix B  
Fact Sheet**

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## Fact Sheet: Harmful Algal Blooms in Utah Lakes

Harmful algal blooms (HABs) are the result of a rapid increase or accumulation of algae on the surface of a water body. Cyanobacteria (or blue-green algae) can flourish and cause blooms in Utah lakes when nutrients, sunlight and temperatures are just right. Some types of blue-green algae can produce toxins which can harm the liver or nervous systems of humans and animals. The algae itself can cause rashes in contact with skin, or stomach and lung problems if it is swallowed or get inhaled by accident.



## How Can I Tell if the Water is Safe?

You may see these blooms on ponds and lakes throughout Utah. They can be a variety of colors, such as fluorescent **blue**, **green**, white, **red** or **brown**. More than one color may be present. They may look like thick paint pools floating on the water and frequently give off a foul odor.



## The Dos and Don'ts of Harmful Algal Blooms

**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.

**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.

**DON'T** let pets lick algae off of their fur.

**DO** rinse yourself and your pet immediately if there is contact with algae-affected waters.

**DO** look for beach postings and water quality notices before swimming.

**DO** get medical treatment right away if you think you, your pet or your livestock might have been poisoned by algal toxins.

## Potential Symptoms

Blue-green algae related illness becomes a concern in Utah as the weather warms and people and pets spend more time outside on or near lakes. Illnesses can be caused by toxins produced by the algae or by the algae themselves. Symptoms will vary depending on the type of exposure.

The most common exposure for **people** is **skin contact** with scum or water containing algae cells or toxins.



### HAB-Related Skin Rash

People may also **inhale** tiny droplets of water containing toxins or cells; this is most common when people are water skiing, wakeboarding, etc.

The most common exposure for **animals** is **ingesting** water with toxins or algal cells.

### Common Human Symptoms Include:

Sore throat, congestion, cough, wheezing, eye irritation, rash, blistering, abdominal pain, headache, vomiting and diarrhea.

### Common Animal Symptoms Include:

Vomiting, lethargy, diarrhea, convulsions, difficulty breathing and general weakness.

If you need urgent information related to a suspected algal exposure, call the

**Utah Poison Control Center:  
1-800-222-1222.**

**For more information: [UDEQ  
contact/webpage; UDOH  
contact/webpage]**