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GeoHealth Newsletter

The U.S. Geological Survey's Environmental Health Newsletter

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Blue-Green Algal Blooms Consistently Produce Cyanotoxins and Taste-and-Odor Causing Compounds

Blue-green algae (cyanobacteria) in Midwestern lakes produce mixtures of cyanotoxins and taste- and-odor causing compounds according to a team of U.S. Geological Survey (USGS) scientists studying the effects of harmful algal blooms. Cyanotoxins can cause allergic and/or respiratory issues, attack the liver and kidneys, or affect the nervous system in mammals, including humans. The findings of this study are significant because studies assessing toxicity and risk of cyanotoxin exposure have historically focused on only one class of toxins (microcystins). The common presence of several types of cyanotoxins indicates that there is the potential to inaccurately quantify hazards using current assessment methods. The findings also suggest that odor (earthy or musty smells) may serve as an additional warning, signaling the presence of cyanotoxins in water, although cyanotoxins can be present even in the absence of taste and odor problems. This study was funded by the USGS Toxic Substances Hydrology Program, the USGS Kansas Water Science Center, and the USGS Office of Water Quality.

Marion Reservoir, Kansas, with a posted advisory warning the public not to come into contact with the cyanobacteria bloom present in the lake (circa 2006). Photo Credit: Jennifer L.

USGS and CDC are Working to Understand a Lead Poisoning Outbreak in Nigeria

Scientists from the USGS and the Centers for Disease Control and Prevention (CDC) are collaborating to understand an outbreak of lethal lead poisoning in Nigeria that is associated with the artisanal processing of gold ores (small-scale activities by individuals rather than large mining companies). A CDC rapid response team collected an extensive suite of samples from several affected villages, including samples of raw and ground ores, contaminated and background soils, water, air, and dust and dirt from living and eating areas. USGS scientists are determining mineralogical, geochemical, and other characteristics of the solid samples. In addition, the scientists are conducting physiologically based extraction tests on the pulverized ore, soils, and dust samples to evaluate the bioaccessibility of contaminants such as lead and other toxic heavy metals. Results of these studies will be used by the CDC, the Nigerian government, and others to help understand the nature and extent of exposure to lead during artisanal ore processing. The results will also aid in the

In several villages of Zamfara State, Nigeria, gold ores are first crushed by hand, and then pulverized in grain grinders such as this one. Gold ore processing in Nigeria has recently expanded and become much more mechanized. Small-scale (artisanal) gold-ore processing activities are a potential and suspected source of lead poisoning among children. These gold ores have a high lead content. Photo Credit: Dr. Antonio

assessment of potential exposures when liquid mercury is used to separate the gold from the ore (a process known as amalgamation -- see photos). USGS scientists are working with the CDC and the U.S. Embassy in Nigeria to explore how earth science information might be used to help shift mining to gold deposits with less lead, and to develop mineralogical and other information that could be used to help develop methods that remove most of the lead minerals from the gold ores prior to processing, thus limiting lead exposure. USGS characterization of mercury contamination in soils and eating area dusts will also aid in the development of ways to help minimize mercury exposure and methods to remediate contaminated soils. The USGS component of this work was made possible with funding from the USGS Mineral Resources Program.

After the gold ore is pulverized the ore is washed, and then the gold is extracted from the ore by mercury amalgamation. As seen in this photo, liquid mercury is mixed with the ore by hand. When the gold comes into contact with mercury an alloy of gold and mercury (amalgam) is formed. Public-health workers are concerned about exposures to mercury vapors. The CDC and United Nations have found high levels of mercury in air from affected villages. Photo Credit: Dr. Antonio Neri (CDC), and James Durant (CDC).

Wildlife Health Reporting Tools May Help Prevent Human Illness

Two new tools that allow the public to report sightings of sick or dead wild animals could also lead to the detection and containment of wildlife disease outbreaks and help reduce associated health threats to humans. The Wildlife Health Event Reporter (WHER) is a new Website that enables anyone with an Internet connection to report sightings of sick or dead wildlife. The other tool is a mobile phone application "Outbreaks Near Me," which relays user reports to the WHER site. The mobile phone application also accepts reports on human illness. The new tools are examples of "citizen science," which capitalizes on the public's ability to help record and map natural phenomena, providing timely information to researchers. Researchers at the Nelson Institute for Environmental Studies at the University of Wisconsin-

The Wildlife Health Event Reporter Website - http://www.wher.org

Madison and the USGS National Wildlife Health Center in Madison created the WHER. The Global Emerging Infections Surveillance and Response System (GEIS) of the U.S. Armed Forces Health Surveillance Center provided funding for the information platform on which WHER is built.

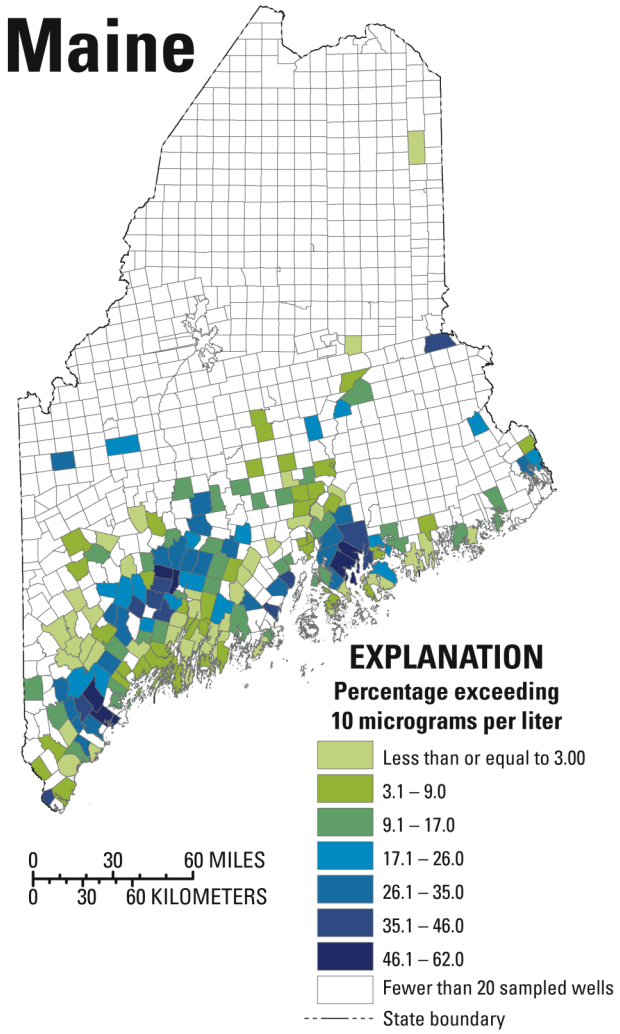
High Arsenic Concentrations Found in Domestic Wells Across Maine

Scientists from the USGS and the Maine Center for Disease Control and Prevention have found potentially harmful concentrations of arsenic in private water wells in towns across Maine. The scientists examined data from more than 11,000 wells in 530 municipalities (cities, towns, and townships) across Maine. In some cases high arsenic was found in municipalities where elevated arsenic risks were not previously suspected. More than 25 percent of the sampled wells in 44 municipalities exceeded the U.S. Environmental Protection Agency's Maximum Contaminant Level (MCL) for arsenic in drinking water of 10 micrograms per liter (µg/L). In 19 towns, more than 10 percent of the sampled wells had arsenic concentrations that exceeded 50 µg/L, and in 45 municipalities, 1 percent or more exceeded 100 µg/L. Data came from water samples submitted to the Maine Health and Environmental Testing Laboratory from 2005 through 2009. These data do not represent a random sample of wells from each municipality; rather, they provide the best indicator of areas with

"We found large differences in concentrations from well to well, even at the town level, so residents need to test their wells to know their arsenic level," said USGS scientist Martha Nielsen, who led the study in cooperation with the Maine Center for Disease Control and Prevention. "We are working with the Maine CDC to identify towns throughout the state where elevated arsenic levels are common but have gone mostly unnoticed."

high concentrations among available datasets and are a better indicator of arsenic hot spots than data from smaller, randomly designed studies.

The distribution of high arsenic concentrations in wells follows some geographic patterns, which are generally geologically controlled. There appear to be three distinct large-scale areas of high concentrations (greater than 50 µg/L) of arsenic in groundwater—one in southern coastal areas, one in central Kennebec County, and one in the town of Ellsworth (Hancock County) and the surrounding areas. In addition, several smaller clusters of isolated high concentrations of arsenic in groundwater exist. There also are areas of the State with low arsenic concentrations, such as the northernmost municipalities, and a few towns in the western and west-central areas.



Percentage of wells in each town with arsenic concentrations greater than 10 micrograms per liter in Maine for samples collected from 2005 through 2009. Towns shown have 20 or more wells. Modified from Figure 15, p. 29 USGS Scientific Investigations Report 10-5199.

This cooperative study, supported in part by the USGS National Water-Quality Assessment Program, was initiated to assist the Maine Center for Disease Control and Prevention in developing a better understanding of the statewide spatial occurrence of wells with elevated arsenic levels at the individual town level, identify areas of the State that should be targeted for increased efforts to promote well-water testing, and generate data for potential future use in predicting areas of the State likely to have very high levels of arsenic. The study is the largest of its kind in Maine.

Responding to Recent Wildfires

USGS scientists collecting samples of ash and burned soil for later laboratory analysis after the September 2010 Fourmile Canyon Fire near Boulder, Colorado. The scientists are determining if the ash and soil could have potential health effects if inhaled. Photo Credit: Gregg Swayze, USGS

The response to two recent wildfires—the 2009 Station Fire near Los Angeles, California, and the September 2010 Fourmile Canyon Fire in the foothills above Boulder, Colorado—involved both reaction to the dangers of the advancing fires as well as investigating longer-term environmental health concerns. For both fires, the broader USGS fire response included helping to (1) evaluate the potential environmental and human-health risks associated with exposure to airfall ash, residual ash, burned soils, and dusts generated from burned areas; and (2) evaluate the impact of the fires on the water quality of streams and rivers affected. Samples of ash, soils, and debris were tested for potential contaminants. Remote sensing measurements were also included in the assessment. A key aspect of fires such as these at the wildland/urban interface is the understanding of potential contaminants released into the environment from people's homes that burned during the fire. USGS studies are providing insights into the processes by which potential toxicants in buildings and building materials are combusted, with resulting implications for public health.

Scientists collected water-quality samples from Arroyo Seco, California, and Fourmile Creek, Colorado, to help evaluate the effect of the wildfires on stream water quality. Arroyo Seco, provides water to a reservoir that's used to recharge an aquifer that's used for drinking water. Fourmile Creek is a tributary to Boulder Creek, and both streams provide drinking water for downstream communities. The streams were sampled for potential contaminants associated with the wildfires. Result of these studies will help water resource managers understand effects of wildfire on streams and downstream water quality.

For the Fourmile Canyon Fire, USGS scientists also provided assistance to the Boulder County Public Health department and

the National Institute for Occupational Safety and Health (NIOSH) Denver Regional Office in identifying informational materials for public release on potential health issues associated with wildfire ash and smoke exposure. The USGS also helped connect local Colorado public health officials with counterparts in California State agencies who deal with such issues on a nearly yearly basis. The fire was the most expensive wildfire in Colorado history, leading to the loss of over 160 homes.

These studies were made possible with funding from the USGS Mineral Resources Program, USGS National Research Program, the USGS Climate and Land Use Change Mission, USGS California Water Science Center, and the Boulder Creek Critical Zone Observatory.

Nitrogen and Phosphorus Still Elevated in Many of Nation's Streams and Aquifers

According to a national study by the USGS, many streams and aquifers across the Nation have elevated concentrations of nitrogen and phosphorus, which have remained the same or increased since the early 1990s. The nutrients nitrogen and phosphorus can negatively impact human health and aquatic ecosystems. The study results found that nitrate is a continuing human-health concern in many shallow aquifers across the Nation that are sources of drinking water. In agricultural areas, more than one in five shallow, private wells contained nitrate at concentrations above the U.S. Environmental Protection Agency's Maximum Contaminant Level (MCL) of 10 milligrams per liter (mg/L) for drinking water. The quality and safety of water from private wells—which are a source of drinking water for about 40 million people—are not regulated by the Federal Safe Drinking Water Act and are the responsibility of the homeowner.

As samples were collected for laboratory analysis, USGS scientists measured water-quality characteristics at groundwater sampling sites across the Nation. Photo Credit: USGS

Because nitrate can persist in groundwater for years and even decades, nitrate concentrations are likely to increase in deep aquifers used for public drinking-water supplies during at least the next decade, as shallow groundwater with high nutrient concentrations moves downward into deeper aquifers. This nationwide assessment of nutrient sources and the human and natural factors that control how nutrients enter our streams and groundwater can help water-resource managers anticipate where watersheds are most vulnerable to contamination and set policies and management actions for impacted resources. This national scale study was funded by the USGS National Water-Quality Assessment Program.

Is There a Connection Between White–Nose Syndrome in Bats and Human Health?

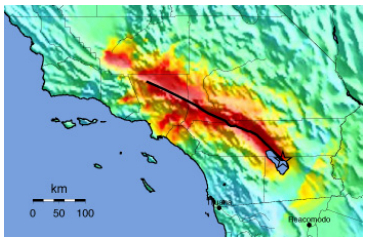
While not likely to pose a direct threat to human health, white-nose syndrome in bats may indirectly affect people. For example, bats are primary predators of insects (a single bat can eat up to 1,200 mosquitoes in one hour), and in areas where bat populations have been decimated, those bats would have consumed large numbers of insects. Many insects, such as mosquitoes, can transmit disease to humans and animals such as West Nile Virus. Insect populations also impact agriculture and forestry, and as a result, declining bat populations could have significant economic impacts, especially as white-nose syndrome encroaches upon the agriculturally intensive Midwest.

Little brown bats hibernating in a cave in New York State. Most of the bats have white fungal growth on their muzzles, which is a common characteristic of white-nose syndrome. Photo Credit: Nancy Heaslip, New York Department of Environmental Conservation

Since March 2008, biologists estimate that over a million bats have died from this disease. White-nose syndrome mortality has been documented in 11 States in the Northeast and Mid-Atlantic. Current estimates of bat population declines since the emergence of the disease are as high as 97 percent in some areas. Scientists with the USGS National Wildlife Health Center, working with many partners, continue to play a primary role in research on white-nose syndrome.

Enhancing Resilience to the Environmental Health Consequences of Disasters: Contributions from the Earth Sciences

Disasters commonly pose immediate threats to human safety and health, but can also release hazardous materials that pose threats to environmental health. USGS scientists and their collogues from Federal and State agencies are working on the development of interdisciplinary scenarios to estimate physical, economic, and other consequences of future natural disasters. These include the 2008 Great Southern California ShakeOut scenario that modeled a geologically plausible 7.8 magnitude



A map of southern California showing simulated shaking intensity from a hypothetical 7.8 magnitude earthquake centered southeast of Los Angeles. Figure 1-2 from USGS Open File Report 2008-1150

earthquake along the southern San Andreas fault, and the ongoing ARkStorm scenario that is modeling the impacts of a potential weeks-long winter storm hitting California. USGS scientists are studying the environmental health implications associated with the ShakeOut and ARkStorm scenarios. They are using Geographic Information Systems (GIS) to bring diverse types of data together to help understand the potential sources, types, environmental behavior, and health implications of hazardous materials predicted to result from these disaster scenarios. These studies enhance planning for, mitigation of, and hence resilience to environmental health consequences of future disasters. This study was made possible with funding from the USGS Mineral Resources Program and funding from the USGS Urban Earth project—A multi-hazards demonstration project in Southern California.

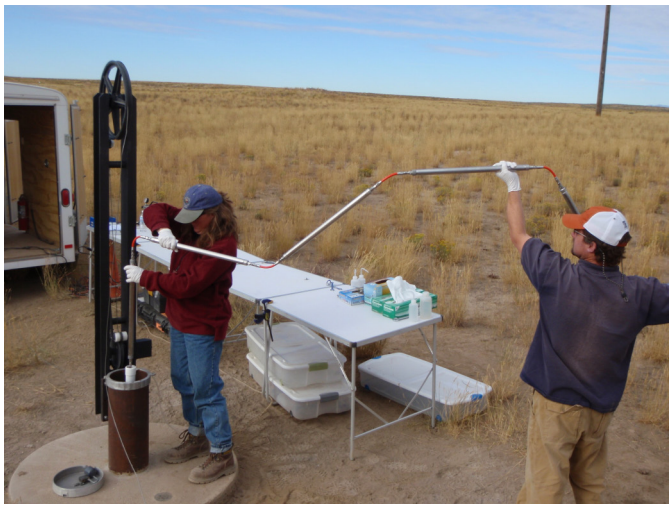
Carbon Dioxide Intrusion in Homes near Reclaimed Coal Mines

In recent years carbon dioxide (CO_2) intrusion has become recognized as a potentially serious health threat where homes with basements are constructed on or near reclaimed surface coal mines. When CO_2 invades the living space of a home, it can displace oxygen and produce a potentially lethal environment. Thankfully, there are no known human fatalities linked to this phenomenon; however, the deaths of several family pets have been attributed to oxygen deficiency caused by CO_2 intrusion. Working in cooperation with the Indiana Department of Natural Resources, Division of Reclamation, USGS scientists studied the environmental factors that most influence CO_2 intrusion to homes. They found that four meteorological conditions (rapid drops in barometric pressure, rain, wind, and cold) all contribute to CO_2 intrusion. When these conditions happen at the same time and at their worst, CO_2 can be present at concentrations sufficient to cause breathing problems and even death. Because weather conditions vary greatly with time, it is often difficult to quickly determine if a home or building is accumulating CO_2. However, because these issues represent a potentially serious health threat, it is prudent, when entering the low levels of any structure, to always be mindful of the telltale signs: pilot lights or candles that will not stay lighted and rapid or labored breathing, headaches, dizziness, or confused thinking. This study was funded by the Indiana Division of Reclamation and the USGS Cooperative Water Program.

A simulated carbon dioxide cloud that has settled above the floor in a typical bedroom. In this case, condensation allowed the dry-ice-generated cloud to be visible; however, in most settings, carbon dioxide generated from natural soil processes will not be visible. Photo Credit: Bret A. Robinson, USGS

Tritium Contamination Seeping Deeper into the Snake River Plain Aquifer

Any news of contamination is usually not good; however, for residents of southeastern Idaho who depend on groundwater, the latest news about tritium (a radioactive form of the hydrogen atom) in their groundwater appears to have a good side. If the tritium, at concentrations well below U.S. Environmental Protection Agency standards but higher than background levels, is moving deeper into the aquifer, there is less chance that it could end up in drinking water because wells typically pump water from the upper levels of the aquifer. The discovery by USGS scientists, working in cooperation with the U.S. Department of Energy, was made possible by some sophisticated subsurface technology.



USGS scientists deploying specialized water-sampling bottles into a well equipped with a multilevel monitoring system at the Idaho National Laboratory, Idaho. Photo Credit: USGS Idaho National Laboratory Project Office.

Since 2005, the USGS has equipped wells at DOE's Idaho National Laboratory with multilevel monitoring systems. Each system consists of multiple sections separated with inflatable, airtight packers. Sections include remotely operated ports through which scientists can collect water samples. Because each section is sealed off from the others, the scientists can collect samples from just one thin layer of the aquifer. This lets the scientists track groundwater contaminants in three dimensions, and allows them to look deeper into the aquifer. The use of this technology led to the discovery of low tritium concentrations in deep groundwater along the southern boundary of the Idaho National Laboratory. Previous monitoring limited to the upper aquifer revealed only

traces of tritium below the margin of error for the analytical methods used to measure tritium. This study was made possible with funding from the U.S. Department of Energy.

Well Construction Linked to Likelihood of Elevated Nitrate Concentrations in Private Wells in Glacial Aquifers

A recent USGS study found that the occurrence of nitrate in private well water in the Nation's glacial aquifers was related to well construction characteristics. Characteristics such as the well diameter and the depth to the top of the well screen (where water enters the well casing) were key to predicting the probability of the nitrate in concentrations greater than 3 milligrams per liter (mg/L) in the well water. Glacial aquifers are water-bearing formations that were deposited by glaciers. For this study by the USGS National Water-Quality Assessment (NAWQA) Program, scientists consider "the glacial aquifer system" to be all unconsolidated aquifers above bedrock north of the line of continental glaciation throughout the Nation. As such, the glacial aquifer system is the largest aquifer in areal extent used for drinking water and public supply in the United States.

The fertilizer used on lush green lawns such as this one and fertilizer applied to row crops nearby could contaminant this home's water-supply well with nitrate. Photo Credit: Kelly L. Warner, USGS

Although some of the highest nitrate concentrations in private wells sampled as part of the NAWQA Program's national study (see above article on elevated nitrogen and phosphorus) were measured in the glacial aquifer system, most nitrate concentrations were near background levels (1 mg/L). Only 4 percent of the private wells sampled in the glacial aquifer system had nitrate concentrations above the U.S. Environmental Protection Agency's Maximum Contaminant Level (MCL) of 10 mg/L, in contrast to a much higher exceedance rate in shallow, private wells in agricultural areas in other parts on the Nation. This is notable because some of the highest nitrogen fertilizer application in the Nation is over the glacial aquifer system. Most private wells are located in rural areas, yet a nitrogen source is often not the most direct indicator of high nitrate in private wells in the glacial aquifer system. The natural change in geochemical conditions with depth, such as reduction/oxidation (redox) potential, also is a limiting factor. Finally, the more information available about well construction and nearby nitrogen sources, the more likely it is that the vulnerability of a given private well in the glacial aquifer system to nitrate contamination can be determined.

The glacial aquifer system that stretches across the northern part of the United States provides 41 million people with drinking water.

Upcoming Meetings

Environmental Health 2011: Resetting our Priorities – Salvador, Brazil, February 6-9, 2011

This conference will provide an interdisciplinary platform to exchange knowledge and learn about the latest issues in environmental health. The main themes of the conference are:

- Environmental health research
- Impacts of technological innovations (including analytic methods)
- Globalization and policy changes to environmental health
- Climate change
- Global environmental disparities
- Environmental health emergencies
- Environmental health ethics
- Human capital resources

Meeting Web Site:
http://www.environmentalhealthconference.com/

The National Map Users Conference and USGS GIS Workshop – Lakewood, Colorado, May 10 - 13, 2011

The first users conference for The National Map and eighth biennial USGS Geographic Information Science (GIS) Workshop will bring together scientists, managers, and data users who, through presentations, posters, seminars, workshops, and informal gatherings, will share accomplishments and progress on a wide variety of geospatial topics. Presentations on the application of GIS technologies to address human and environmental health issues will be featured in the USGS Science Strategy and The National Map user track.

Meeting Web Site: http://nationalmap.gov/uc/index.html

Environmental Health Risk 2011: 6th International Conference on the Impact of Environmental Factors on Health – Riga, Latvia, July 25-27, 2011

The objective of this conference is to provide a forum for the dissemination and exchange of information on the diverse aspects of the impact of environmental factors on health across different disciplines. The papers presented at this conference and past conferences are permanently archived in the Wessex Institute's eLibrary.

Meeting Web Site: http://www.wessex.ac.uk/11-conferences/environmentalhealthrisk-2011.html

4th International Conference on Medical Geology (GEOMED 2011) – Bari, Italy, September 20-25, 2011

The International Medical Geology Association (IMGA) and the Italian Chapter of IMGA are sponsoring the 4th International Conference on Medical Geology on September 20-25, 2011, in Bari, Italy. The conference provides an opportunity for mineralogists, physicians, soil scientists, toxicologists, geochemists, biologists, chemists, and other specialists to share ideas and knowledge on the impact of the environment on public and animal health. The conference will focus on the following themes:

- Air, Soil and Water Pollution and Quality
- Minerals and the Environment
- Environmental Toxicology and Epidemiology
- Biominerals and Biomaterials
- Risk Assessment and Communication in Medical Geology

Meeting Web Site: http://www.geomed2011.it/

139th American Public Health Association (APHA) Annual Meeting and Exposition – Washington, D.C., October 29-November 2, 2011

APHA's meeting program addresses current and emerging health science, policy, environmental health, and practice issues in an effort to prevent disease and promote health. The theme for the meeting is "Healthy Communities Promote Healthy Minds and Bodies."

Meeting Web Site http://www.apha.org/meetings/

The GeoHealth Newsletter provides information on: New USGS activities related to human health, upcoming meetings related to earth science and public health, and new and upcoming USGS health-related publications. The Newsletter is issued twice a year.

Sign up to receive e-mail notifications of new issues at:

http://health.usgs.gov/geohealth/ghnewsletter/

New Publications

Coming Soon!

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