

The Environmental Risks of Lithium-Ion Batteries

and the effects of lithium, cobalt, graphite, nickel and
manganese toxicity on plants and animals

a list of sources
compiled by Emily Hermann

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INTRODUCTION

I am including direct quotes from the linked sources below. I myself did not write any of this, this is straight from the source. These sources include experiments/labs, books, public college resources, and essays. These are sites I've learned about in school and at my job. I, myself would feel comfortable using these sources for any school related essay. I have included a few magazine and news articles as they can be just as important, showing first hand experiences by writers and local citizens living through what we may see in the future.

Publications from other countries are included as well as it is important to understand how the rest of the world is being affected.

I have included a direct quote from almost every website that I feel is the best summary. Please read the full writing if interested to gain full context.

The Environmental Risks of Lithium-Ion Batteries

Most of these articles are focused around lithium mining, however this is still relevant to our topic due to the fact that the same exact chemicals are being released during a fire and any waste coming from the factory (contaminated garbage and fumes). All waste has the potential to pollute the air and water as seen in the links below. Key themes are bolded at the beginning of each quote.

Harm to Nature

(fish, farming, animals) “For example, a small dose of lithium has a significant inhibitory effect on the proliferation and growth of aquatic organisms including *Pimephales promelas*, *Ceriodaphnia dubia*, and *Elimia clavaeformis* [16]. Also, lithium in water can accumulate in plants and cause damage to plant growth and development [17, 18]. For example, 60 mmol/L of lithium can damage the growth of sunflower; the same concentration can also affect the growth of corn [17]. Lithium can be enriched in animals by food chains, and high concentrations of lithium can also cause severe damage to animals [19]. For instance, rats were treated with small doses of lithium for 7 weeks (every alternate day) [20]. The epithelium lining of renal tissue was injured, and some significant changes were observed in the glomerular region in the corticomedullary region [20]. Besides, high concentrations of lithium could cause severe damage to humans, including the nervous system (including coarse tremor and hyperreflexia), kidney (including sodium-losing nephritis and nephrotic syndrome), and endocrine system (including hypothyroidism).” <https://enveurope.springeropen.com/articles/10.1186/s12302-020-00333-6>

(SpringerOpen, SpringerOpen publications are subject to high-level peer review, editorial, author and production services, ensuring the quality and reliability of the work) (Emily’s Note: once you go to the website of this article, you will find that each bracketed number correlates to another website where you can read the full experiment!)

(water contamination, fish, animals) “In 2009, a lithium mining project located in China, known as the Ganzizhou Rongda Lithium mine, was blamed for leaking toxic waste into the Liqi River which flows through Tibet. Villagers in the area have accused the facility of poisoning the waters, resulting in the death of vast numbers of fish, destroying sacred grassland, and even killing hundreds of yak who happened to drink from the river water... The harm to the environment doesn't start and end with lithium extraction. Unfortunately there are several other ingredients in lithium and lithium-ion batteries that are also cause for concern Cobalt and nickel for example are two components that come with a heavy environmental cost.”

<https://greenly.earth/en-us/blog/ecology-news/the-harmful-effects-of-our-lithium-batteries> **(Greenly, a resource for companies for CO2 emission management)**

(air pollution) “The production of lithium-ion batteries that power electric vehicles results in more carbon dioxide emissions than the production of gasoline-powered cars and their disposal at the end of their life cycle is a growing environmental concern as more and more electric vehicles populate the world's roads.”

<https://www.instituteforenergyresearch.org/renewable/environmental-impacts-of-lithium-ion-batteries/#:~:text=The%20production%20of%20lithium%2Dion,vehicles%20populate%20the%20world%27s%20roads.> **(Institute For Energy Research)**

(animal reproduction) “A compound such as NMP (N-methyl-2-pyrrolidone) is harmful to the foetus – as a substance that damages reproductive abilities, it is subject to EU restrictions, i.e. it can only be used under strict restrictions. This substance was detected in the groundwater near the Samsung plant in Göd in tests funded by non-governmental organisations.”

<https://www.greenpeace.org/hungary/environmentally-speaking-what-is-wrong-with-battery-factories-appearing-in-hungary/#:~:text=Hazardous%20and%20toxic%20substances%20surrounding%20the%20factories&text=Many%20dangerous%20and%20toxic>

[%20chemicals,the%20factory%20is%20in%20operation.](#)

(Greenpeace, Greenpeace is a global network of independent campaigning organizations that use peaceful protest and creative confrontation to expose global environmental problems and promote solutions that are essential to a green, just, and joyful future.)

(river and groundwater contamination) “However, there are also negative impacts associated with this mining, including chemical leaks into rivers and groundwater and the destruction of natural habitats and human-made societies where the metal is extracted.”

[https://www.mckendree.edu/academics/scholars/bossart-](https://www.mckendree.edu/academics/scholars/bossart-issue-36.pdf)

[issue-36.pdf](https://www.mckendree.edu/academics/scholars/bossart-issue-36.pdf) **(Lithium Batteries: How they Affect the World, and What Else we can Use By Oscar Bossart)**

(fish, animals, water contamination) “In May 2016, hundreds of protestors threw dead fish onto the streets of Tagong, a town on the eastern edge of the Tibetan plateau. They had plucked them from the waters of the Liqi river, where a toxic chemical leak from the Ganzizhou Rongda Lithium mine had wreaked havoc with the local ecosystem.

There are pictures of masses of dead fish on the surface of the stream. Some eyewitnesses reported seeing cow and yak carcasses floating downstream, dead from drinking contaminated water. It was the third such incident in the space of seven years in an area which has seen a sharp rise in mining activity, including operations run by BYD, the world’s biggest supplier of lithium-ion batteries for smartphones and electric cars. After the second incident, in 2013, officials closed the mine, but when it reopened in April 2016, the fish started dying again.”

<https://www.wired.co.uk/article/lithium-batteries-environment-impact>

(WIRED UK, WIRED is a monthly American magazine, published in print and online editions, that focuses on how emerging technologies affect culture, the economy, and politics.)

(Humans, animals, farms, fish, water contamination) “Health Respiratory Issues. Lithium-ion batteries contain chemical substances that are harmful to human and animal respiratory systems... In both the past and recent years, there have been reports of ruined farms and carcasses of dead animals identified in and around some of the mining sites. For instance, in a small town in China, dead fish and animals were discovered in rivers that were either surrounding or near Tibetan mines.”

<https://www.cenex-lcv.co.uk/news-media/exhibitor/what-is-the-environmental-impact-of-lithium-batteries#:~:text=Lithium%20batteries%20have%20chemicals%20within,water%20and%20destroying%20aquatic%20life>. **(LCV Cenex, centre of excellence for low carbon and fuel cell technologies)**

(fish, soil, air pollution, water pollution, animals) “In Nevada, researchers found impacts on fish as far as 150 miles downstream from a lithium processing operation. Lithium extraction harms the soil and causes air contamination. In Argentina’s Salar de Hombre Muerto, residents believe that lithium operations contaminated streams used by humans and livestock and for crop irrigation. In Chile, the landscape is marred by mountains of discarded salt and canals filled with contaminated water with an unnatural blue hue. According to Guillermo Gonzalez, a lithium battery expert from the University of Chile, “This isn’t a green solution – it’s not a solution at all.””

<https://www.instituteforenergyresearch.org/renewable/the-environmental-impact-of-lithium-batteries/> **(Institute For Energy Research)**

Harm to Humans

While I can understand environmental and agricultural jargon, medical jargon is where I lack. I still felt the need to include these sources as they are easy to read and made for the public and training for employees directly working with lithium-ion batteries.

Unfortunately, one of my favorite resources was created based on information taken before the lithium battery plants in question came to existence. This is still a good resource however, for those who are curious about any other local factories' cancer and pollution risks.

ProPublica: <https://projects.propublica.org/toxmap/> **(Interactive cancer risk map for local factories)**

“HEALTH EFFECTS:

Eyes: Severe irritation and burns

Skin: Severe irritation and burns

Inhalation: Nose, throat and lung irritation with coughing and severe shortness of breath (pulmonary edema)

Headache, muscle weakness, confusion and seizures”

<https://nj.gov/health/eoh/rtkweb/documents/fs/1119.pdf> **(New Jersey Department of Health, Right to Know Fact Sheet)**

“(Ignition of Lithium-ion batteries cause harmful gases to be released)... which destroy the surface layers of the human body, and very toxic due to the fluoride ions (F⁻), which penetrate deep into the body and cause cell necrosis. The chelation of fluoride ions on calcium and magnesium causes hypocalcaemia and hypomagnesaemia as well as the destruction of underlying tissues. The depletion of these elements leads to an excess of potassium and causes a biological imbalance which can present as heart arrhythmias.”

<https://www.prevor.com/en/li-ion-batteries-chemical-hazard-inside-our-cars/#:~:text=Organic%20carbonates%20in%20liquid%20or,of%20prolonged%20or%20repeated%20contact.> **(PREVOR, Toxicology and Chemical Risk Management)**

Other Environmental Risks

I am also including the risks of each chemical that can be used to make lithium-ion batteries.

Cobalt, Co Toxicity: (Animals)

(rat experiment)

<https://pubmed.ncbi.nlm.nih.gov/2646660/#:~:text=In%20addition%2C%20excess%20dietary%20cobalt,induce%20respiratory%20deficiency%20in%20yeast.> **(National Library of Medicine, Domingo JL. Cobalt in the environment and its toxicological implications)**

“If your dog has been exposed to cobalt for a long time, the reaction may be hard to treat, but will usually respond well in time. However, in this type of chronic poisoning, your dog will probably need medication for the rest of his life. In the case of an acute poisoning, your dog should recovery right away with treatment and be back to normal in a few days. To prevent this from happening again, keep items with cobalt, such as batteries and magnets, out of reach of your dog.” <https://wagwalking.com/condition/cobalt-poisoning> **(Wag! Resources for dog caregivers)**

(Fish)

(Tilapia experiment)

<https://corescholar.libraries.wright.edu/cgi/viewcontent.cgi?article=1023&context=jbm> **(Wright State University, Journal of Bioresource Management)**

“High cobalt concentrations in aquatic environments can cause DNA damage and chromosomal fragmentation.” <https://www.sciencedirect.com/science/article/pii/S0269749119347220#:~:text=High%20cobalt%20concentrations%20in%20aquatic.et%20al.%2C%202013.> **(ScienceDirect is a website that provides access to a large bibliographic database of scientific and medical publications)**

(Plants)

(Tomato Experiment)

<https://www.tandfonline.com/doi/full/10.1081/CSS-120018963?scroll=top&needAccess=true> **(Taylor and Francis Online, Communications in Soil Science and Plant Analysis Volume 34, 2003)**

“The toxicity symptoms include interveinal chlorosis of new leaves, white leaf margins and tips, leaf chlorosis and damaged root tips...In *Lilium longiflorum*, the inhibition by Co of pollen germination and pollen tube growth has been associated with the swelling of the tip region and abnormal cell wall organization in the tube... Cobalt and other heavy metals affect photosynthesis and the activities of related enzymes”

<https://digital.library.adelaide.edu.au/dspace/bitstream/2440/19399/2/02whole.pdf> **(University of Adelaide, Cobalt: Physiological Effects and Uptake Mechanisms in Plants by Juhong Liu)**

**Graphite Toxicity:
(Animals)**

“Acute signs include anorexia, vomiting, abdominal pain, behavior changes, ataxia, tremors, hyperexcitability and intermittent seizures.

Chronic signs tend to be more vague and may include abdominal discomfort, vomiting, diarrhea, anorexia, lethargy, weight loss, anemia, behavior changes, intermittent seizures and megaesophagus (rarely reported in cats).”

<https://www.aspcapro.org/resource/understanding-and-treating-lead-toxicosis> (ASPCapro provides training, research and resources to help animal welfare professionals save more lives.)

(Fish)

NO SOURCES FOUND AT THIS TIME

(Plants)

NO SOURCES FOUND AT THIS TIME

Nickel, Ni Toxicity: (Animals)

“Nickel’s toxic effects may affect different organ systems, leading to respiratory problems, gastrointestinal disturbances, impaired growth, and reproductive disorders in livestock species... Nickel and its compounds are used in various industrial processes, such as metal plating, stainless steel production, and battery manufacturing. Industrial emissions release nickel particles and compounds into the atmosphere, which can subsequently settle onto pasturelands and crops, contaminating animal feed.”

<https://www.srpublication.com/nickel-toxicity-in-animals-and-its-impact-on-livestock-health-a-comprehensive-review/> (SR

Publications, technical magazines dedicated to Poultry Industry and Livestock Industry, Nickel Toxicity in Animals and Its Impact on Livestock Health: A Comprehensive Review)

(Fish)

“Nickel exposure induced some histological changes in fish gill structure...The physiological and histological changes indicate that nickel is very hazardous pollutant.”

<https://scialert.net/fulltext/?doi=jbs.2007.77.85> (Atef M. Al-Attar, 2007. The Influences of Nickel Exposure on Selected Physiological Parameters and Gill Structure in the Teleost Fish, *Oreochromis niloticus*. *Journal of Biological Sciences*, 7: 77-85.)

(Plants)

“Contamination of soils with heavy metals, such as nickel (Ni), is a major environmental concern due to increasing pollution from industrial activities...Excess Ni induces leaf chlorosis and inhibits plant growth... this heavy metal induces gravitropic defects and locally inhibits root growth by suppressing cell elongation without significantly disrupting the integrity of the stem cell niche.”

<https://academic.oup.com/pcp/article/61/3/519/5637233> (Oxford Academic, *Plant and Cell Physiology*, Volume 61, Issue 3, March 2020, Pages 519–535)

Manganese, Mn Toxicity: (Animals)

“Mn is also a common environmental contaminant, which can cause toxic effects in animals and humans. In addition to reproductive and developmental effects, Mn toxicity is primarily associated with neurological effects... in all domestic animals and poultry, excess dietary Mn is known to cause reduced feed intake, growth rate, and lethargy.”

<https://www.sciencedirect.com/science/article/abs/pii/B9780128114100000301#:~:text=Clinical%20signs%20of%20toxicity%20include,%2C%20growth%20rate%2C%20and%20lethargy.>

(Science Direct, Veterinary Toxicology (Third Edition) Basic and Clinical Principles 2018, Pages 445-454)

(Fish)

(Grouper Experiment)

<https://pubmed.ncbi.nlm.nih.gov/35271901/#:~:text=Overall%2C%20the%20findings%20showed%20that,in duces%20toxicity%20in%20marine%20fish.> **(Wang X, Gao XQ,**

Wang XY, Fang YY, Xu L, Zhao KF, Huang B, Liu BL.

Bioaccumulation of manganese and its effects on oxidative stress and immune response in juvenile groupers

(*Epinephelus moara* ♀ × *E. lanceolatus* ♂). *Chemosphere*.

2022 Jun;297:134235. doi: 10.1016/

j.chemosphere.2022.134235. Epub 2022 Mar 7. PMID:

35271901.)

(Plants)

“For example, beans, lettuce, potato, and roses are considered sensitive (less tolerant of Mn)...in watermelon, the toxicity is so dramatic that we named it the “sudden crash” syndrome. As this name implies, the crop looks quite healthy and grows rapidly from transplanting (or seed- ing) to flowering, or sometimes to the early fruit-filling stage, and then the older leaves suddenly wilt, dry up, and

drop in a matter of days (see p. 4). Loss of leaves reduces the plant's ability to absorb sunlight for photo- synthesis, resulting in reduced fruit set, fruit size, and quality (not sweet enough by commercial standards)... Mn toxicity symptoms vary with plant species and among plant tissue organs. On older leaves, Mn toxicity symptoms generally appear as small, distinct, dark-brown spots, necrotic lesions, and chlorosis of leaf edges and tips... On young, expanding leaves, Mn toxicity symptoms are commonly known as "crinkle leaf": the leaf cups upward, crinkles, is smaller than normal, and has chlorotic edges."

<https://www.ctahr.hawaii.edu/oc/freepubs/pdf/SCM-1.pdf> (University of Hawaii, Soil and Crop Management June 1998 SCM- 1)

About Me

My name is Emily Hermann. I have a love for protecting the environment and for gaining knowledge.

I have received training in the following areas through work, school, and growing up in agriculture:

- Soil testing and composition
- Bonide
- Jonathan Green
- Native plants & animals
- How to treat indoor plants, outdoor plants, and lawns for diseases and insects with organic and man-made solutions.
- Specific nutrients needed for growing specific vegetables and how chemicals affect them
- Caring for livestock

I have an understanding on how chemicals effect the environment, specializing in plants. I have even taught on this subject in an elementary school setting. It is my goal to provide reliable resources to share my information with those interested.

To be honest I had no interest at all in the whole Gotion protest until I thought to myself, "How will this effect the environment." The hate on Facebook was loud; but my deep love for knowledge, the environment, and serving my community were louder.

Final Note

Thank you for reading, this took me several hours to compile. I appreciate everyone who has encouraged me while writing this and all of the friends I have made in the community this far.

If you have further questions (or criticisms) please read the article in its entirety and feel free to explore other writings on each site. Some pages give contact information for further questions for the author/school. I also highly recommend reaching out to the direct source for further questions, as I cannot answer for them. I am just a messenger with enough time on her hands to gather information for other curious minds.

Genesis 1:26

Genesis 1:31

Genesis 2:15

Numbers 35:33-34

Psalms 8:6-9

Psalms 24:1

Revelation 11:18