



## Arsenic in Soils

Office of Land Quality

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### Description

- Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants in many areas of the United States, including Indiana. Background concentrations vary widely throughout the state, including some areas where natural soil concentrations may exceed Indiana Department of Environmental Management's (IDEM's) 2022 residential soil published level of 10 parts per million. The published level is a conservative estimate of a concentration that is known to be safe in a residential setting where children are present, and exposure is continual. Citizens who are concerned about arsenic can successfully manage the risk by implementing measures, such as those described below, to reduce exposure.
- Arsenic can be released into the environment as a byproduct of industrial activities, such as wood preservation, mining, coal combustion, and smelting. Some products manufactured with arsenic include pesticides, paints, dyes, metals, drugs, soaps, and semi-conductors. Approximately 90% of all arsenic industrially produced is used as a preservative for wood to make it resistant to rotting and decay.

### Routes of Exposure

- Major exposure pathways for arsenic are:
  - Ingestion – eating food that is grown in arsenic-contaminated soil, direct ingestion of soil, and/or drinking well water containing arsenic. For exposures to arsenic in drinking water, see IDEM's Fact Sheet; *Arsenic* ([www.idem.IN.gov/files/factsheet\\_owq\\_dw\\_arsenic.pdf](http://www.idem.IN.gov/files/factsheet_owq_dw_arsenic.pdf)).
  - Inhalation – generally this exposure route is associated with workplace exposure, such as working in coal-fired power plants, glass manufacturing operations, pesticide manufacturing facilities, and smelters. Tobacco smoke and breathing dust generated from dry soil can also be inhalation sources.
- The largest route of exposure is through ingestion. Foods grown in arsenic-contaminated soil may include low levels of arsenic. The highest known levels of arsenic in grown foods are in rice, which generally is not grown in Indiana. Produce, such as root vegetables, can have measurable arsenic concentrations but rarely at levels that can cause a health concern. Arsenic generally binds to the soil which is why plant uptake is limited.
- Children can be particularly vulnerable to ingestion and inhalation of arsenic due to outdoor play on exposed soils, contact and potential ingestion via hand-to-mouth activities, and ingestion of soil. Note that EPA has determined that only a fraction of the arsenic present in soil can be absorbed through contact with the soil. Most arsenic that is ingested passes through the body and exits via urination.

### Potential Health Effects

- Ingesting or breathing low levels of arsenic over a long period of time can cause darkening of the skin; the appearance of small corns or warts on the palms, soles, and torso; nausea and vomiting; decreased production of red and white blood cells; abnormal heart rhythm; and damage to blood vessels.
- Ingesting very high levels of arsenic over a short period of time can be extremely hazardous to a person's health. Exposures to these levels is almost exclusively in a work environment. The immediate symptoms of acute arsenic poisoning include vomiting, abdominal pain, and diarrhea. These are followed by numbness and tingling of the extremities, muscle cramping, and death, in extreme cases.

- Breathing high levels of arsenic can cause a sore throat or irritated lungs.
- According to the National Institutes of Health, there is some evidence that long-term exposure to arsenic in children may result in lower IQ scores.
- Arsenic is a known human carcinogen, and studies have shown that ingestion of arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation can increase the risk of lung cancer.

## **Reduce Exposure**

Things that households can do to reduce exposure to naturally occurring and other arsenic in soil:

- Add compost to garden soils from an arsenic free source. Organically rich soils limit plant uptake of arsenic.
- Conduct raised bed gardening with arsenic free soils.
- Wear gloves and wash hands after gardening.
- Thoroughly wash all produce prior to consumption, particularly for root vegetables such as carrots, potatoes, rutabagas, radishes, and turnips. As an added measure of precaution, peel these vegetables as well. In general, it is not the produce itself but the soil that adheres to the produce that poses the greatest arsenic exposure risk. Fruiting plants (tomatoes, berries, peppers, melons, etc.) are much less likely to contain arsenic.
- In areas of known contamination, avoid the brassica family (broccoli, cabbage, brussels sprouts), which have a high arsenic uptake potential.
- Cover bare soils with grasses or mulch.
- Wipe shoes on an outside doormat or remove shoes upon entering the home.
- Regularly wash children's hands after outside play and clean toys regularly.

## **Additional Resources**

For more information on arsenic, see:

- The Agency for Toxic Substances and Disease Registry (ATSDR) website at <https://www.cdc.gov/TSP/PHS/PHS.aspx?phsid=18&toxid=3#bookmark07>
- Centers for Disease Control (CDC) Information Center at 1-800-232-4636
- Arsenic and Cancer Risk by the American Cancer Society <https://www.cancer.org/healthy/cancer-causes/chemicals/arsenic.html>
- Arsenic and Children by the Dartmouth Toxic Metals Superfund Research Program <https://sites.dartmouth.edu/arsenicandyou/arsenic-and-children/>
- Arsenic gardening tips by the State of Washington Department of Ecology <https://ecology.wa.gov/Spills-Cleanup/Contamination-cleanup/Dirt-Alert-program/Gardening-tips>
- For information on arsenic exposure at work, please visit CDC's NIOSH website <https://www.cdc.gov/niosh/topics/arsenic/default.html>
- Marion County Public Health Laboratory (phone 317-221-4670) tests garden soils for arsenic and other metals for \$30 <https://marionhealth.org/programs/population-health/public-health-laboratory/> Other labs listed in the EPA's National Lead Laboratory Accreditation Program will likely provide arsenic analyses as well <https://www.epa.gov/system/files/documents/2022-03/nllap.pdf>
- Geochemical and Mineralogical Maps for Soils of the Conterminous United States by the United States Geological Service: <https://pubs.usgs.gov/sir/2017/5118/elements/Arsenic/OFR-2014-1082-As.pdf>
- For questions and concerns about arsenic contamination or environmental cleanup, contact IDEM's Office of Land Quality at (317) 232-3215 or (800) 451-6027, ext. 2-3215.
- To report an accidental release or spill, call IDEM's 24-Hour Spill line at (888) 233-7745 (toll free).