

Other routes of exposure include incidental soil ingestion and through the use of home products like:

- Wood preservatives
- Paints
- Dyes
- Medicines

How does arsenic affect your Health?

Many factors determine harmful effects and the type and degree of those health effects:

Dose

How much arsenic you are exposed to?

Duration:

How long you have been exposed to arsenic?

Genetic susceptibility:

Family traits

Route:

Drinking/eating (ingestion), breathing (inhalation), or skin (dermal) contact

Individual characteristics:

Age, general health and lifestyle

Most of the toxic effects arise from exposure to inorganic arsenic and affects nearly all organ systems of the body. Arsenic is known to cause cancer in humans (human carcinogen). Ingested inorganic arsenic increases a person's risk to develop lung, skin, bladder, breast, prostate, kidney and liver cancer. Other toxic effects of concern are related to:

- Heart and blood vessels (cardiovascular)
- Stomach and intestines (gastrointestinal)
- Kidney effects
- Liver
- Nerves and nervous system (neurological)
- Lungs (pulmonary)
- Child birth (reproductive)
- Respiratory
- Blood & blood forming organs (hematology)
- Dermal (skin)

Want to learn more about arsenic?

Arizona Department of Environmental Quality
<http://www.azdeq.gov/>

Agency for Toxic Substances and Disease Registry
<http://www.atsdr.cdc.gov/cabs/arsenic/index.html>
<http://www.atsdr.cdc.gov/toxguides/toxguide-2.pdf>

US Environmental Protection Agency
<http://www.epa.gov/safewater/arsenic/index.html>

World Health Organization
http://www.euro.who.int/document/a1q/6_1_arsenic.pdf

National Institute of Environmental Health, Superfund Basic Research Program
<http://www-apps.niehs.nih.gov/sbrp/>

Brought to you by:

U.S. - Mexico Binational Center



College of Pharmacy



College of Agriculture and Life Sciences

The mission of the Binational Center is to resolve environmental and human health challenges along the US - Mexico Border by:

Providing and supporting environmental science and toxicology training, research, and policy development.

Facilitating a binational dialogue between investigators and stakeholders concerning risk assessment and remediation problems.

For further information, please contact:

Denise Moreno, Program Coordinator
 1703 East Mabel Street
 Tucson, Arizona 85721-0207
 Telephone: 520.626.9049, Fax: 520.626.2466
dmoreno@pharmacy.arizona.edu
www.binational.pharmacy.arizona.edu

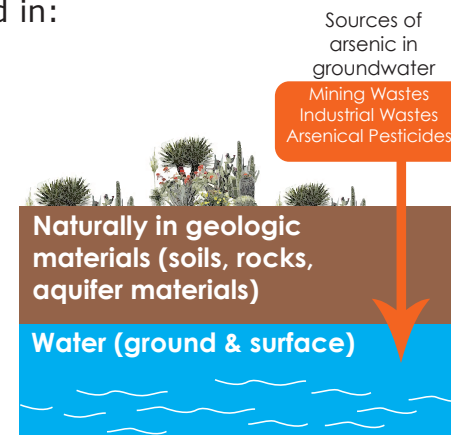
What is arsenic?



Arsenic is a solid substance (metalloid) naturally existing in the Earth's crust and in crushed rock.

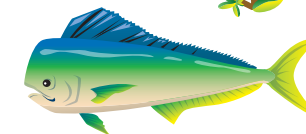
Arsenic exposure is natural but can be aggravated by human activities. We are exposed to arsenic in two chemical forms:

- **Inorganic** - Varying amounts of this poisonous (toxic forms) form can be found in:



- **Organic** - (arsenic compounds that contain carbon) - Varying amounts of this non-poisonous (low-toxicity) form are found in:

- Animals
- Plants
- Fish and Seafood



How can I be exposed arsenic?

Most people take in (ingest/inhale) small amounts of arsenic from:

- Drinking water
- Air dust (particulates)
- Food

Too much arsenic taken in may result in harmful side effects. In the general environment, the ingestion is the main route of absorption of arsenic. In occupational environments, arsenic is absorbed mainly through the lungs. **The chart below illustrates how a person can be exposed to arsenic.**

Routes of Exposure	Why is arsenic present?
Drinking water	<p>Ask yourself - Where does your drinking water come from? Due to natural geologic contamination (remember arsenic exists naturally in the Earth's crust and some forms dissolve in water) communities that get their drinking water from underground (groundwater), can potentially be exposed to excessive amounts of arsenic.</p> <p>Surface water can be contaminated by contact with soils, sediments and mine tailings (large piles of crushed rock left over after minerals have been extracted from the rocks which contained them) that contain arsenic, runoff and wastewaters contaminated with arsenic, arsenic-containing pesticides and industrial wastes.</p>
Air	<p>Arsenic attached to very small particles may stay in the air for many days and travel long distances. Exposure to dust with elevated arsenic levels may come from agricultural (use of pesticides and fungicides and farming), mining (mine tailings, smelters, particles high in arsenic), inhaling smoke (burning of oil, gasoline, wood, coal), and lifestyle activities such as tobacco smoking (tobacco products have small amounts of arsenic, because of past application of arsenic-containing pesticides).</p>
Food	<p>Most foods contain low levels of arsenic. Fish, seafood, algae and rice can contain elevated levels of organic forms of arsenic, however these forms of arsenic have much lower toxicities than inorganic forms.</p>

The development of health problems depends on how much arsenic got into their bodies and how much was absorbed. Either high concentrations and short exposures or low concentrations and long-term exposures can cause the above health effects. Most arsenic is rapidly discharged in urine and does not accumulate in the body.

In most cases, it is safe to use water that contains arsenic for bathing, laundering, showering, and washing dishes, because arsenic does not easily get into your skin. It is not safe to cook with or drink water with levels of arsenic above the Maximum Contamination Level (MCL), please see table or below.

What are the government policies concerning arsenic?

Drinking water standards

In comparison, the levels of arsenic in water within the southwestern US and northern Mexico typically range from 2 - 100 ppb. Together, the US Environmental Protection Agency (US EPA) and state government agencies are responsible for monitoring arsenic in public water systems. Privately owned wells are not monitored by government agencies, though MCL information is available for private well owners. If you are not using your local drinking water company or community water supply, you should test your well water.

Air Standards

Arsenic is listed as a hazardous air pollutant (HAP); meaning arsenic is a substance that may increase mortality or serious illness in humans after significant exposure. These standards must be met the workplace. EPA limits emission of inorganic arsenic from primary copper smelters, glass-manufacturing and arsenic plants. However, there is no federal air standard for arsenic, like the water standards above.

Food Standards

The US Department of Agriculture has prohibited the use of arsenic in organic crop production. Currently, the US Food and Drug Administration (US FDA) has not established tolerance levels for arsenic in food, except for bottled water and the byproducts of animals treated with veterinary drugs.

Arsenic (As) Standards Table

Source	Federal Agency	Standard/Regulations
Public drinking water	US EPA	MCL = 10 parts per billion (ppb), or 10 µg/L
Bottled drinking water	US FDA	10 parts per billion (ppb), or 10 µg/L
Air	US Department of Labor, Occupational Safety & Health Administration	8-hour total weight average (TWA)* permissible exposure limit (PEL) for general industry of: inorganic = 10 µg/m (micrograms of As per cubic meter of air) organic = .5 mg/m ³ (milligrams of As per cubic meter of air)
Food	US EPA	Tolerance level for an organic form of arsenic residue in fruits and citrus at .035 ppb.
	US FDA	Regulation applies only to the byproducts of animals treated with veterinary drugs. 0.05 ppb in eggs and uncooked edible tissues of chickens and turkeys to 0.2 ppb in certain uncooked edible by-products of pigs and others.

*TWA is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded.

How can I find out if my drinking water is safe?

The best way to prevent health problems related to arsenic exposure is with knowledge. The only way to know if your drinking water contains arsenic is to have it tested. By Federal law public water utilities must test the drinking water they deliver and provide an annual quality report to their costumers known as a Consumer Confidence Report (CCR). This report is a general overview of the water quality of that system and will show which regulated contaminants such as arsenic were found in the drinking water and quantities identified from the previous year.

If you own a water source or have a private well, you can take a water sample to a state certified laboratory. In Arizona call 602-364-0728 for a list of state certified laboratories.

Lastly, be aware of the historical usages of the area in and around your home. Find out if an old industrial site, mine or smelter or a Hazardous Waste or Municipal Solid Waste Landfill is or was located near your home. In addition, look into whether the land you live upon was once a farmland, and test your soil. Note that all soils contain natural levels of arsenic. These range from 1-50 mg/kg worldwide, but some soils in Arizona may have even higher natural levels of arsenic. Therefore, it is normal for plants take up some arsenic. But arsenic plant uptake is also dependent on other factors such as soil pH, texture, organic matter, soil arsenic chemical forms, and plant types and varieties. Edible plants should not be cultivated in soils containing Arsenic levels above the mid range (~20-25 mg/kg) stated above, but no "unsafe" arsenic soil standards are available. Concerned homeowners may have their garden soil tested and compared to natural background arsenic levels in their area.

Also, the may have fruits and plants tested for arsenic to determine whether they meet the US EPA standard listed above. Note again that the US FDA does not have an arsenic standard for foods other than bottled water and the byproducts of animals treated with veterinary drugs.

How is arsenic removed (reduced) from drinking water?

Arsenic levels can be reduced to drinking water safe levels using two different technologies:

- **Adsorption process:** water passes through a filter where the arsenic sticks to a filter (media column) made of another metal like iron, alumina zirconium or titanium.
- **Reverse Osmosis process (RO):** water passes through a layer (membrane) that filters out the arsenic.

These technologies can be installed at different places like public water utilities or residences. These implementation points are categorized and described below.

Before water reaches your residence

- **Centralized Treatment Plant:** ground-water from the well goes directly to a treatment plant reducing the arsenic level before it is distributed to residences.
- **Well Head:** groundwater from the well is treated to reduce arsenic levels right after it is removed from the well.

At your residence

- **Point of Entry:** arsenic levels are reduced before it enters the home.
- **Point of Use:** arsenic levels are reduced within the home. For example, a device would be installed under a kitchen or bath room sink.