

33

As

Arsenic
74.92159

WHAT IS ARSENIC?

Arsenic is a metal-like element that is found in rocks and soil. It comes from natural sources such as volcanoes and geothermal activity. It can also come from industrial processes such as mining, smelting and coal-fired power plants. It was also used as a pesticide until the 1980s.



Common arsenic-containing minerals:
arsenopyrite (top), arsenic sulfide
(bottom).

ARSENIC IN WELL WATER

HOW DOES IT END UP IN DRINKING WATER?

The majority of arsenic in drinking water comes from natural sources. Arsenic can leach out of the soil and minerals into groundwater. It can also enter surface water and groundwater from mine tailing waste and industrial activities.

Higher levels of arsenic are typically found in groundwater. There are some regions in the U.S., including New England, the Southwest, and the Pacific Northwest where you are more likely to find elevated levels of arsenic in groundwater. Many households in these regions rely on groundwater as their source of drinking water.

WHO TESTS FOR ARSENIC?

The U.S. Environmental Protection Agency's Safe Drinking Water Act requires municipally-supplied drinking water to be tested for arsenic. If you own a private well that supplies water that is used for drinking and other domestic uses, it is your responsibility to test for arsenic.

“Arsenic is odorless and tasteless. The only way to find out if it is in your water is to test for it.”

After a long review of the health data related to chronic arsenic exposure, the United States Environmental Protection Agency (EPA) lowered the enforceable standard for arsenic in drinking water from 50 micrograms per liter ($\mu\text{g/L}$) to 10 $\mu\text{g/L}$ in 2001.

Private drinking water wells are not regulated by the EPA. Although some states, including Oregon, require property owners to test private drinking water wells for arsenic during real estate transactions and disclose the test results to the buyer and the Oregon Health Authority Drinking Water Program.

WHAT ARE THE HEALTH EFFECTS?

If you are exposed to arsenic, many factors will determine if you will be harmed. The most important factors that influence the health risk posed from drinking water that contains arsenic is its concentration in the water and how long you have been drinking that water.

Drinking water that contains elevated levels of arsenic for a long period of time is linked to many health problems including skin lesions, high blood pressure, cardiovascular damage, bronchitis, impaired nerve functioning, and type 2 diabetes. The U.S. Department of Health and Human Services has determined that arsenic can cause cancer. Subsequently, drinking elevated levels of arsenic for a long period of time may increase the risk of bladder, lung, skin, kidney and liver cancer.

Children are more susceptible to all environmental chemicals, including arsenic. Arsenic can cross the placenta and reach the developing child which makes pregnant women more susceptible to arsenic as well.

WHAT TO DO IF IT IS IN YOUR WATER

- Do not boil the water. Arsenic is a metal and cannot be removed by boiling the water. In fact, boiling the water will lead to evaporation which will increase the concentration of arsenic in the water.
- Re-test your water to confirm the results. In general, it is recommended that the water quality in private wells be tested at least once a year.
- Drinking and cooking with bottled water will reduce your exposure to arsenic.
- Be sure to keep a well log and note any water quality issues. Regular inspections of your drinking water well will also help identify potential problems.

There are several treatment methods that can remove arsenic from drinking water including reverse osmosis and anion exchange systems. There are also a few considerations that need to be kept in mind when choosing the most appropriate method for your situation. There are point-of-use systems that can be installed under the kitchen sink. These point-of-use systems are less expensive than point-of-entry systems that treat all the water coming into the home.

It is important to consult with a water quality company to identify the correct water treatment system for your house. Other minerals in the water can influence the performance of drinking water systems. These could include iron or manganese which would hinder the effectiveness of arsenic removal. Therefore you may need a pre-treatment system to remove these minerals prior to treating the water for arsenic. It is important to note that your treatment equipment must be carefully maintained in order to work properly. Some treatment equipment may not be effective if arsenic levels are very high. In

these cases, the best treatment option may be switching to another drinking water source. This could include rain water catchment, digging a new well, or sharing a water source with a neighbor. These alternatives should be discussed with your local or state health department.

The following table was created by the Oregon Health Authority to provide guidance to people based on the concentration of arsenic in their drinking water.

Arsenic Level	Water Use	Recommendations
10 µg/L or less	<p>SAFE for drinking, cooking and all other domestic uses</p> <p>SAFE for animals</p>	Test water every 3 years
10 – 99 µg/L	<p>NOT SAFE for drinking, mixing into beverages, cooking or washing fruits and vegetables</p> <p>NOT SAFE for animals to drink</p> <p>SAFE for all other domestic uses, including bathing, washing dishes, doing laundry or irrigating gardens</p>	<p>Use bottled water or approved water filtration system for drinking, cooking and washing fruits and vegetables</p> <p>Supervise children to ensure they do not swallow water while bathing, brushing teeth, etc.</p> <p>Utilize other water sources or rain catchment for irrigating fruits and vegetables grown for human consumption</p>
100 – 499 µg/L	<p>Same restrictions as above</p> <p>NOT SAFE for irrigating gardens – arsenic may build up in soil and accumulate in plants, to include vegetables</p>	<p>If you have a treatment system, test treated water at least once a year.</p> <p>Test untreated water (pre-treatment unit) at least every 3 years</p>
500 µg/L and above	<p>NOT SAFE for any domestic uses</p>	<p>Contact your local or state health department</p>

Oregon Health Authority:

<http://public.health.oregon.gov/healthyenvironments/drinkingwater/monitoring/healtheffects/pages/arsenic.aspx>

DIFFERENT UNITS FOR DESCRIBING ARSENIC CONCENTRATIONS

Arsenic concentrations in water can be reported in different units. This is often a sort of confusion and frustration. The following table defines common units used to report arsenic concentrations, as well as, how to convert between different units.

Units of Measurement	Arsenic	
	Definition	
ppb	Parts per billion	Equivalent to $\mu\text{g/L}$ 1 molecule out of 1 billion molecules
$\mu\text{g/L}$	Microgram/Liter	Equivalent to PPB
ppm	Parts per million	Equivalent to mg/L 1 molecule out of 1 million molecules.
mg/L	Milligram/Liter	Equivalent to PPM
Conversion Formula's		
ppb \rightarrow ppm Divide by 1000 <i>Example:</i> 100 PPB arsenic = 0.1 PPM arsenic		ppm \rightarrow ppb Multiply by 1000 <i>Example:</i> 1 PPM arsenic = 1000 PPB arsenic
ppb \rightarrow $\mu\text{g/L}$		ppb are equivalent to $\mu\text{g/L}$. If arsenic levels are 10ppb, you can easily convert to $10\mu\text{g/L}$
$\text{mg/L} \rightarrow \mu\text{g/L}$ There are 1000 mg to a gram 1000 μg to a mg Multiply by 1000 <i>Example:</i> $10 \text{ mg/L} \times (1000\mu\text{g}/1 \text{ mg}) = 10,000 \mu\text{g/L}$		$\mu\text{g/L} \rightarrow \text{mg/L}$ If there are 1000 μg to a mg, then divide by 1000 <i>Example:</i> $500 \mu\text{g/L} \times (1\text{mg}/1000\mu\text{g}) = 0.5 \text{ mg/L}$ <i>Or written differently,</i> $500\mu\text{g/L} \div 1000 = 0.5 \text{ mg/L}$