

1. PUBLIC HEALTH STATEMENT

This public health statement tells you about boron and the effects of exposure to it.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites are then placed on the National Priorities List (NPL) and are targeted for long-term federal clean-up activities. Boron and boron compounds have been found in at least 164 of the 1,689 current or former NPL sites, respectively. Although the total number of NPL sites evaluated for this substance is not known, the possibility exists that the number of sites at which boron is found may increase in the future as more sites are evaluated. This information is important because these sites may be sources of exposure and exposure to this substance may be harmful.

When a substance is released either from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. Such a release does not always lead to exposure. You can be exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance, or by skin contact.

If you are exposed to boron, many factors will determine whether you will be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider any other chemicals you are exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

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1.1 WHAT IS BORON?

Naturally occurring	Boron is a widely occurring element in minerals found in the earth's crust. It is the 51 st most common element found in the earth's crust and is found at an average concentration of 8 mg/kg (approximately 0.0008%).
Combines with oxygen to form borates	Boron is found in the environment primarily combined with oxygen in compounds called borates. Common borate compounds include: <ul style="list-style-type: none"> • boric acid • sodium tetraborates (also referred to as borax) • boron oxide
Used to manufacture industrial and consumer products	Borate-containing minerals are mined and processed to produce borates for several industrial uses in the United States including: <ul style="list-style-type: none"> • glass and ceramics • soaps, bleaches, and detergents • fire retardants • pesticides \

More information on the properties and uses of boron and boron compounds and how they behave in the environment may be found in Chapters 4, 5, and 6.

1.2 WHAT HAPPENS TO BORON WHEN IT ENTERS THE ENVIRONMENT?

Released into air, water, and soil	Boron can be released into air, water, or soil after natural weathering of soils and rocks. Smaller amounts of boron can be released from: <ul style="list-style-type: none"> • glass manufacturing plants • coal-burning power plants • copper smelters • agricultural fertilizer and pesticide usage.
Is not broken down	Boron cannot be destroyed in the environment. It can only change its form or become attached or separated from particles in soil, sediment, and water.

For more information on boron in the environment, see Chapter 6.

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1.3 HOW MIGHT I BE EXPOSED TO BORON?

Food	You can be exposed to boron in food, mainly vegetables and fruits, as boron is an essential element in plants. The average daily intake of boron for adults is 1 milligram.
Water	<p>Boron is widely distributed in surface water and groundwater.</p> <ul style="list-style-type: none"> • the average surface water concentration is about 0.1 mg per liter (mg/L) • boron concentrations in ground water can be as high as 300 mg/L in areas with natural boron-rich deposits • concentrations up to 0.4 mg/L have been found in most drinking water samples.
Soil	Average concentrations of 26 and 33 mg per kilogram (mg/kg) have been reported in soil.
Air	The general public is not likely to be exposed to air contaminated with boron. The average level of boron in air samples is 0.00005 mg boron per cubic meter of air (mg boron/m ³).
Workplace air	In workplaces that mine and process borates, boron concentrations in dusty air samples have been reported to range from about 0.5 to 3 mg boron/m ³ .
Consumer products	<p>Boric acid, anhydrous sodium tetraborate, and sodium tetraborate decahydrate (borax) are found in consumer products such as:</p> <ul style="list-style-type: none"> • laundry detergent • pesticides • facial creams and cleaners • plant foods • household cleaners

Further information on how you might be exposed to boron is given in Chapter 6.

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1.4 HOW CAN BORON ENTER AND LEAVE MY BODY?

Most ingested boron is absorbed	Boron can enter your body when you eat food (fruit and vegetables), drink water containing it, when you breathe borate dust in the air, and when damaged skin comes in contact with it.
Typically leaves your body within 4 days	Most of the boron leaves the body in urine. Over half of the boron taken by mouth can be found in urine within 24 hours and the other half can be detected in urine for up to 4 days.

Further information on how boron enters and leaves the body is given in Chapter 3.

1.5 HOW CAN BORON AFFECT MY HEALTH?

This section looks at studies concerning potential health effects in animal and human studies.

One way to learn whether a chemical will harm people is to determine how the body absorbs, uses, and releases the chemical. For some chemicals, animal testing may be necessary. Animal testing may also help identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method for getting information needed to make wise decisions that protect public health. Scientists have the responsibility to treat research animals with care and compassion. Scientists must comply with strict animal care guidelines because laws today protect the welfare of research animals.

The effect of boron on human health depends on how much boron is present, how you are exposed to it, and the length of exposure.

Exposure in air	People working in dusty workplaces where borates are mined and processed have reported irritation of the nose, throat, and eyes. The irritation does not persist for long periods after leaving the dusty area.
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Exposure by ingestion	<p><i>Humans:</i> Exposure to large amounts of boron (about 30 g of boric acid) over short periods of time can affect the stomach, intestines, liver, kidney, and brain and can eventually lead to death.</p> <p><i>Animals:</i> Studies of dogs, rats, and mice indicate that the male reproductive organs, especially the testes, are affected if large amounts of boron are ingested for short or long periods of time. The doses that produced these effects in animals are more than 1,800 times higher than the average daily intake of boron in food by adults in the U.S. population.</p> <p>No evidence of cancer was found in a study in which mice were given boric acid in the diet throughout their lifetime.</p>
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More information on the health effects of boron in humans and animals can be found in Chapters 2 and 3.

1.6 HOW CAN BORON AFFECT CHILDREN?

This section discusses potential health effects in humans from exposures during the period from conception to maturity at 18 years of age.

Children are likely to have similar effects as adults	It is likely that children would show the same health effects as adults. We do not know whether children differ in their susceptibility to the effects of boron.
Birth defects	We do not know whether boron causes birth defects in people. Low birth weights, birth defects, and developmental delays have occurred in newborn animals whose mothers were orally exposed to high doses of boron (as boric acid). The doses that produced these effects in pregnant animals are more than 800 times higher than the average daily intake of boron in food by adult women in the U.S. population.

1.7 HOW CAN FAMILIES REDUCE THE RISK OF EXPOSURE TO BORON?

If your doctor finds that you have been exposed to substantial amounts of boron, ask whether your children might also have been exposed. Your doctor might need to ask your state health department to investigate.

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Boron is part of the natural environment and you will have some exposure from foods and drinking water.

Limit children's exposure to pesticides	Pesticides containing boron compounds should be used according to their directions and should be kept away from children.
Store household chemicals out of reach of young children	Always store household chemicals in their original labeled containers out of reach of young children to prevent accidental poisonings. Never store household chemicals in containers children would find attractive to eat or drink from, such as old soda bottles.
Discourage children from eating dirt or putting hands in their mouth while playing with dirt	Children living near waste sites containing boron and boron compounds are likely to be exposed to higher than normal environmental levels of boron through breathing in boron-containing dust, touching soil, and eating contaminated soil. Children should be encouraged to wash their hands frequently, especially before eating.

1.8 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO BORON?

Can be measured in blood and urine	Blood and urine can be examined to determine whether excessive exposure to boron has occurred. The detection of boron in the blood or urine cannot be used to predict the kind of health effects that might develop from that exposure.
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Further information on how boron can be measured in exposed humans is presented in Chapters 3 and 7.

1.9 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. The EPA, the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA) are some federal agencies that develop regulations for toxic substances. Recommendations provide valuable guidelines to protect public health, but cannot be enforced by law. The Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH) are two federal organizations that develop recommendations for toxic substances.

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Regulations and recommendations can be expressed as “not-to-exceed” levels, that is, levels of a toxic substance in air, water, soil, or food that do not exceed a critical value that is usually based on levels that affect animals; they are then adjusted to levels that will help protect humans. Sometimes these not-to-exceed levels differ among federal organizations because they used different exposure times (an 8-hour workday or a 24-hour day), different animal studies, or other factors.

Recommendations and regulations are also updated periodically as more information becomes available. For the most current information, check with the federal agency or organization that provides it.

Some regulations and recommendations for boron include the following:

Levels in drinking water set by EPA	<p>The EPA has determined that exposure to boron in drinking water at concentrations of 4 mg/L for one day or 0.9 mg/L for 10 days is not expected to cause any adverse effects in a child.</p> <p>The EPA has determined that lifetime exposure to 1 mg/L boron is not expected to cause any adverse effects.</p>
Levels in workplace air set by OSHA	<p>OSHA set a legal limit of 15 mg/m³ for boron oxide in air averaged over an 8-hour work day.</p>

Additional information on governmental regulations regarding boron can be found in Chapter 8.

1.10 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns, please contact your community or state health or environmental quality department, or contact ATSDR at the address and phone number below.

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses that result from exposure to hazardous substances.

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Toxicological profiles are also available on-line at www.atsdr.cdc.gov and on CD-ROM. You may request a copy of the ATSDR ToxProfiles™ CD-ROM by calling the toll-free information and technical assistance number at 1-800-CDCINFO (1-800-232-4636), by e-mail at cdcinfo@cdc.gov, or by writing to:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Environmental Medicine
1600 Clifton Road NE
Mailstop F-62
Atlanta, GA 30333
Fax: 1-770-488-4178

Organizations for-profit may request copies of final Toxicological Profiles from the following:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161
Phone: 1-800-553-6847 or 1-703-605-6000
Web site: <http://www.ntis.gov/>