ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

# FLUORIDES, HYDROGEN FLUORIDE, AND FLUORINE

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**Division of Toxicology ToxFAQs™** **September 2003**

**This fact sheet answers the most frequently asked health questions (FAQs) about fluorides, hydrogen fluoride, and fluorine. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.**

**HIGHLIGHTS: Fluorides are naturally occurring compounds. Low levels of fluorides can help prevent dental cavities. At high levels, fluorides can result in tooth and bone damage. Hydrogen fluoride and fluorine are naturally-occurring gases that are very irritating to the skin, eyes, and respiratory tract. These substances have been found in at least 188 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).**

## What are fluorides, hydrogen fluoride, and fluorine?

Fluorides, hydrogen fluoride, and fluorine are chemically related. Fluorine is a naturally-occurring, pale yellow-green gas with a sharp odor. It combines with metals to make fluorides such as sodium fluoride and calcium fluoride, both white solids. Sodium fluoride dissolves easily in water, but calcium fluoride does not. Fluorine also combines with hydrogen to make hydrogen fluoride, a colorless gas. Hydrogen fluoride dissolves in water to form hydrofluoric acid.

Fluorine and hydrogen fluoride are used to make certain chemical compounds. Hydrofluoric acid is used for etching glass. Other fluoride compounds are used in making steel, chemicals, ceramics, lubricants, dyes, plastics, and pesticides.

Fluorides are often added to drinking water supplies and to a variety of dental products, including toothpaste and mouth rinses, to prevent dental cavities.

## What happens to fluorides, hydrogen fluoride, and fluorine when they enter the environment?

❑Fluorine cannot be destroyed in the environment; it can only change its form. Fluorine forms salts with minerals in soil.
❑Hydrogen fluoride gas will be absorbed by rain and into clouds and fog to form hydrofluoric acid, which will fall to the ground.
❑Fluorides released to the air from volcanoes and industry are carried by wind and rain to nearby water, soil, and food sources.
❑Fluorides in water and soil will form strong associations with sediment or soil particles.
❑Fluorides will accumulate in plants and animals. In animals, the fluoride accumulates primarily in the bones or shell rather than in soft tissues.

## How might I be exposed to fluorides, hydrogen fluoride, and fluorine?

❑The general population can be exposed to fluorides in contaminated air, food, drinking water and soil.
❑People living in communities with fluoridated water or high levels of naturally-occurring fluoride may be exposed to higher levels.
❑People who work or live near industries where fluoride-containing substances are used may be exposed to higher levels.

## How can fluorides, hydrogen fluoride, and fluorine affect my health?

Small amounts of fluoride help prevent tooth cavities, but high levels can harm your health. In adults, exposure to high levels of fluoride can result in denser bones. However, if exposure is high enough, these bones may be more fragile and brittle and there may be a greater risk of breaking the bone. In animals, exposure to extremely high doses of fluoride can result in decreased fertility and sperm and testes damage.



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Fluorine and hydrogen fluoride are very irritating to the skin, eyes, and respiratory tract. At high levels, such as may occur through exposure from an industrial accident, hydrogen fluoride may also damage the heart.

### How likely are fluorides, hydrogen fluoride, and fluorine to cause cancer?

Most of the studies of people living in areas with fluoridated water or naturally high levels of fluoride in drinking water did not find an association between fluoride and cancer risk. Two animal cancer studies were inconclusive. The international Agency for Research on Cancer (IARC) has determined that the carcinogenicity of fluoride to humans is not classifiable.

### How can fluorides, hydrogen fluoride, and fluorine affect children?

When used appropriately, fluoride is both safe and effective in preventing and controlling cavities. Drinking or eating excessive fluoride during the time teeth are being formed (before 8 years of age) can cause visible changes in teeth. This condition is called dental fluorosis. At very high concentrations of fluoride, the teeth can become more fragile and sometimes can break.

No studies have addressed whether low levels of fluoride will cause birth defects in humans. Birth defects have not been found in most studies of animals.

### How can families reduce the risk of exposure to fluorides, hydrogen fluoride, and fluorine?

In the home, children may be exposed to high levels of fluorides if they swallow dental products containing fluoridated toothpaste, gels, or rinses. Parents should supervise brushing and place at most, a small pea size dab of toothpaste on the brush and teach children not to swallow dental products. People who live in areas with high levels of naturally-occurring fluoride in the water should use alternative sources of dinking water, such as bottled water.

### Is there a medical test to show whether I've been exposed to fluoride, hydrogen fluoride, and fluorine?

Tests are available to measure fluoride levels in urine; these tests can determine if you have been exposed to higher-than-normal levels of fluorides. The urine test must be performed soon after exposure because fluoride that is not stored in bones leaves the body within a few days. The test cannot be performed in the doctor's office, but can be done at most laboratories that test for chemical exposure. The urine fluoride test cannot be used to predict the nature or severity of toxic effects. Bone sampling can be done in special cases to measure long-term exposure to fluorides.

### Has the federal government made recommendations to protect human health?

The EPA has set a maximum amount of fluoride allowable in drinking water of 4.0 milligrams per liter of water (4.0 mg/L). For the prevention of dental decay, the Public Health Service (PHS) has, since 1962, recommended that public water supplies contain between 0.7 and 1.2 milligrams of fluoride per liter of drinking water.

The Occupational Safety and Health Administration (OSHA) has set limits of 0.2 milligrams per cubic meter (0.2 $mg/m^3$) for fluorine, 2.0 $mg/m^3$ for hydrogen fluoride, and 2.5 $mg/m^3$ for fluoride in workroom air to protect workers during an 8-hour shift over a 40-hour work week.

### Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological Profile for Fluorides, Hydrogen Fluoride, and Fluorine. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service

**Where can I get more information?** For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.