



Module 2: Learning About Lead in Drinking Water

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Health Effects of Lead

Lead is a toxic metal that is harmful to human health. There is no safe blood lead level for children. In the human body, toxic lead can substitute for healthy calcium, which is a mineral that strengthens the bones. Lead is carried in the bloodstream and can harm the nervous system and brain. What is not excreted is absorbed into the bones, where it can collect for a lifetime.

The only way to determine a child’s lead level is to have the child’s blood tested. Contact a health provider to learn more about blood lead testing.

Young children are especially susceptible to lead exposure, because of their frequent hand-to-mouth activity, and their metabolism—their bodies absorb metals at a higher rate than the average adult does. Children’s nervous systems are still undergoing development and thus are more vulnerable to the effects of toxic agents.

Pregnant and nursing staff should also be aware of the harmful risks of lead exposure to nursing infants and the developing fetuses of pregnant women. Mothers who have had exposure to lead in the past may store lead in their bones. Lead may be released from bones during pregnancy and lactation. Lead in drinking water can be a significant contributor to overall exposure to lead, particularly for infants whose diet consists of liquids made with water, such as baby food, juice, or formula.

Lead can affect almost every organ and system in the body. The central nervous system is particularly sensitive to lead, especially in children. Lead also damages the kidneys and the reproductive system. Even low blood levels of lead (those below 5 micrograms per deciliter ($\mu\text{g}/\text{dL}$)) have been associated with reduced IQ and attention span, learning disabilities, poor classroom performance, hyperactivity, behavioral problems, impaired growth, and hearing loss. Because childhood lead exposure often occurs with no immediate symptoms, it frequently goes unrecognized. The degree of harm from lead exposure depends on a number of factors including the frequency, duration and level of the exposure(s) and individual susceptibility factors (e.g., age, previous exposure history, nutrition, and health). In addition, the degree of harm depends on one’s total exposure to lead from all sources in the environment—air, soil, dust, food, paint, consumer products, and water.

Sources of Lead

Lead is distributed in the environment through both natural and man-made means. Sources of lead exposure include the following:

- Lead-based paint.** The most common sources of lead exposure for children are chips and particles of deteriorated lead paint. Although children may be exposed to lead from paint directly by swallowing paint chips, they are more often exposed to lead in house dust or soil contaminated by leaded paint. Lead paint chips can be ground into tiny pieces that become part of the dust and soil in and around homes. This usually occurs when leaded paint deteriorates or is subject to friction or abrasion (as on doors, windowsills, and window wells). In addition, lead can be dispersed when paint is disturbed during demolition, remodeling, paint removal or preparation of painted surfaces for repainting.
- Lead in water.** Typically, lead in water occurs through corrosion of plumbing products containing lead.
- Lead in the air** typically comes from industrial activities.
- Lead in soil.** In most cases, lead deposits in soils around roadways and streets and homes come from past emissions from automobiles using leaded gas, together with lead paint chips and dust.
- Lead from industrial activities.** Industrial workers can bring lead home on their clothes and shoes.
- Lead in consumer products and food.** Lead may be found in some imported candies, medicines, dishes, toys, jewelry, and plastics.

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Air



Consumer Products



Paint



Soil



Industry



Drinking Water

The U.S. government has taken important steps over the past several decades to dramatically reduce new sources of lead in the environment:

- Banning the manufacture and sale of leaded paint.
- Phasing out lead additives in gasoline.
- Encouraging the phase-out of lead seams in food cans.
- Banning the sale of plumbing for drinking water that are not “[lead-free.](#)”
- Limiting lead content in children's products.
- Banning lead-lined water coolers.
- Regulating lead in the nation’s drinking water systems

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How Lead Gets in Drinking Water

Source Water

Lead is rarely present in the source water for the nation’s drinking water supplies (i.e., untreated water from streams, rivers, lakes, or underground aquifers that is used to supply private wells and public drinking water). While lead can enter source water from contaminated runoff or water pollution, treatment plant technologies can remove lead from these sources.

Through Corrosion

Corrosion can release lead from pipes, solder, fixtures, and other plumbing materials that the water comes in contact with on its way from the water treatment system to the tap. The extent to which corrosion of plumbing materials occurs can affect the amount of lead that is present in the drinking water. Most lead in school and child care facility drinking water results from corrosion of older plumbing materials containing lead. Interior lead solder (commonly used until 1988) and lead pipe and lead solder, leaded brass fittings, valves, and various drinking water outlets (e.g., water fountains and faucets) that contain lead materials are the primary contributors. It is also important to note that brass plumbing components can contain lead.

The occurrence and rate of corrosion depend on the nature of the source water, the corrosion control practices at the water system, and the age of the plumbing materials in the building. For information on how chemical and physical conditions can be controlled to reduce lead in drinking water, contact the state drinking water program, which is typically housed in the state department of health or the department of environmental protection.



Particulate Lead

Particles of lead in drinking water, may result from physical corrosion of lead distribution system and interior plumbing components. Physical disturbances (e.g., construction), pipe replacement, and connection of new fixtures can cause the release of lead particles from system and plumbing components. This release can result in temporary, but significant, increases of lead levels in the water. Lead particles may also collect in the low-lying sections of pipe or behind faucet and fixture screens, increasing risk of exposure. Not all analysis methods account for particulate lead. For example, some field analyzer methods are not designed to account for particulate lead. See [Selecting a Laboratory for Sample Analysis](#) for more information on laboratory analysis of lead in water.

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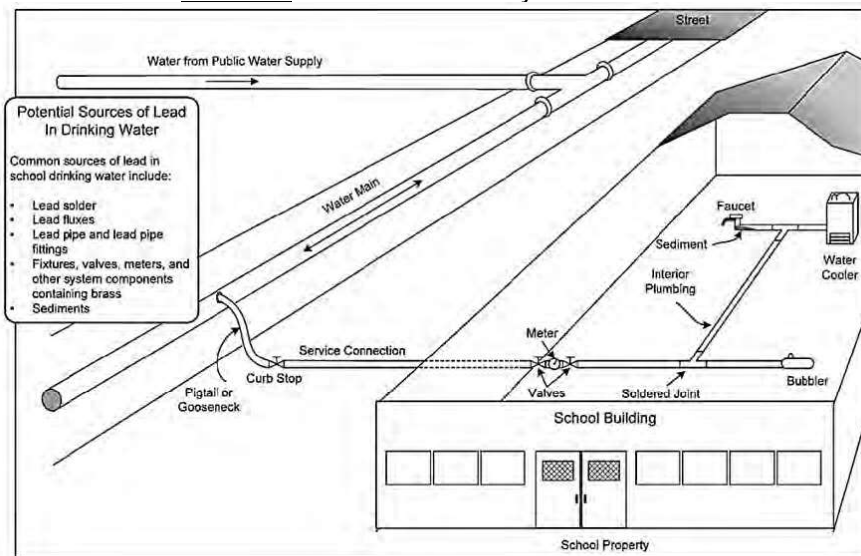
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Your Facility and the Public Water System Relationship

As illustrated in Exhibit 1 below, once the water enters the distribution system – the network of pipes that carry water to homes, businesses, schools, and child care facilities in the community – the water may come into contact with lead. Some communities have lead components in their distribution systems, such as lead joints in cast iron mains, service connections (or service lines), and goosenecks or pigtails, which connect the water main to service lines. These components may be owned by the water supplier, or they may be owned by the school or child care facility. In addition, the drinking water may come into contact with plumbing materials that contain lead once the water enters the building.

Exhibit 1. Potential Sources of Lead in Schools



If the public water system finds unacceptable levels of lead during sampling under the Lead and Copper Rule (LCR), the public water system may have to provide centralized treatment or take other actions to minimize the corrosion of lead into the water (see [How Lead in Drinking Water is Regulated](#) below). However, centralized treatment by a public water system does not guarantee that corrosion of lead from plumbing will not occur within buildings served by the public water system, such as schools. It is important to note that the lead testing protocol used by public water systems is aimed at identifying system-wide problems rather than problems at outlets in individual buildings.

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How Lead in Drinking Water is Regulated

Lead is regulated in public drinking water systems under a federal regulation known as the Lead and Copper Rule. This regulation was initially issued in 1991 and, in part, requires water systems to test for lead and copper and to take actions that reduce corrosivity and protect public health.

Nearly all states have a drinking water office that implements the Safe Drinking Water Act (SDWA). Questions regarding the regulation of drinking water may be directed to the appropriate state drinking water program office or state licensing agency.

Picture of a Scratch on a Lead Service Line



Requirements addressing lead in water include specific provisions in:

- **THE SDWA LEAD BAN (1986):** A requirement that only “lead-free” materials be used in new plumbing and in plumbing repairs. In the 1986 ban, “lead-free” meant that solders and flux may not contain more than 0.2 percent lead, and pipes and pipe fittings may not contain more than 8.0 percent lead. It is likely that lead pipes and high-lead solder and fluxes continued to be used until 1988 in several states and territories, and until 1989 or 1990 in a few states, but other state or local governments may have imposed related lead-ban standards prior to 1988.
- **THE LEAD CONTAMINATION CONTROL ACT (LCCA) (1988):** The LCCA is aimed at the identification and reduction of lead in drinking water at schools and child care facilities, including the recall of drinking water coolers with lead lined tanks and the publication of a list of drinking water coolers that were not “lead

free” as defined by the LCCA (no more than 8% lead for components that come into contact with water and no more than 0.2% percent lead for solder, flux, or storage tank interior that comes into contact with water).

- THE LEAD AND COPPER RULE (1991):** A regulation by EPA to control the amount of lead and copper in water supplied by public water systems through corrosion control treatment, and other measures. Modifications were made to the Lead and Copper Rule in 2000 and 2007 to include revised requirements on demonstrating optimal corrosion control, monitoring, and reporting, treatment processes, public education, customer awareness, and lead service line replacement.
- THE REDUCTION OF LEAD IN DRINKING WATER ACT (2011):** This act further reduced lead in pipes, pipe fittings, plumbing fittings, and fixtures to a weighted average of 0.25 percent. The act also redefined “lead-free” under the SDWA as not containing more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

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