Zinc

Symbol:	**Zn**
Atomic Number: *(protons in nucleus)*	**30**
Atomic Weight:	**65**

What Is It? Zinc is one of the most common elements in the earth's crust. It is also an essential element for all living things. Pure zinc is a bluish-white, shiny metal. Powdered zinc is explosive and can burst into flames if stored in a damp place. Because it is an element, zinc does not degrade nor can it be destroyed.

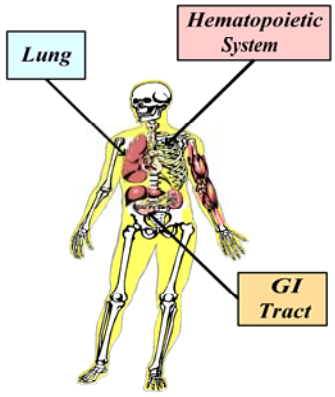
How Is It Used? Zinc has many commercial and industrial uses. Metallic zinc is used to coat iron and other metals to prevent rust, and it is also used in dry cell batteries. Zinc is mixed with other metals to form alloys such as brass and bronze, and pennies are made from a copper-zinc alloy. Zinc is also combined with other elements such as chlorine, oxygen, and sulfur to form zinc compounds used to make white paints, ceramics, rubber, wood preservatives, dyes, and fertilizers. Zinc compounds are also used in the drug industry as ingredients in common products like sun blocks, diaper rash ointments, deodorants, athlete's foot preparations, acne and poison ivy preparations, and anti-dandruff shampoos.

What's in the Environment? Zinc is found throughout the environment in air, soil, and water, and it is present in all foods. It can be released by natural processes, but most results from human activities. Releases to air, water, and soil are common in areas where ores are mined, processed, and smelted for zinc. Because cadmium and lead are commonly present in zinc-containing ores, they are also typically released during these processes and so areas are often jointly contaminated. Zinc can be releases to the atmosphere during the production of steel and burning of coal or waste. Surface water can be impacted by discharges of metal manufacturing and chemical industry wastes, and also by run-off following precipitation on soils high in zinc, either due to the natural setting or human applications, including use of zinc fertilizer on agricultural soils.

The average concentration of zinc in air (as fine dust particles) is typically less than 1 microgram per cubic meter (µg/m^3), although concentrations of 5 µg/m^3 have been measured near industrial sources. In lakes and rivers, some zinc remains dissolved in water or as fine suspended particles, while other zinc settles to the bottom in association with heavier particles. Average concentrations range from 0.02 to 0.05 milligram per liter (mg/L) in surface water and 0.01 to 0.1 mg/L in drinking water. Levels U.S. soils typically range from 10 to 300 mg/kilogram (kg), with an average concentration of about 50 mg/kg. Zinc generally remains in the upper layers bound to soil particles, but it can leach to groundwater depending on soil characteristics, moving more readily in sandy soil. Concentrations of zinc in sandy soil particles are about 200 times higher than in the water between the soil particles, and concentration ratios are even higher (over 1,000) in both loam and clay soils.

Some fish may accumulate zinc, but it does not build up in plants. The typical ratio of the concentration in plants to that in soil is estimated at 0.9 (or 90%). Zinc has been measured in food at concentrations ranging from 2 parts per million (ppm) in leafy green vegetables to 29 ppm in meat, fish, and poultry. On average, people ingest 7 to 163 mg of zinc every day.

What Happens to It in the Body? Zinc is one of the most abundant trace elements in the human body. It is typically taken in by ingestion of food and water, although it can also enter the lungs by inhaling air, including that contaminated with zinc dust or fumes from smelting or welding activities. The amount of zinc that can pass directly through the skin is very small. Absorption of zinc into the bloodstream following ingestion is normally regulated by homeostatic mechanisms, so the balance between zinc intake and excretion is controlled. Absorption from the gastrointestinal tract is 20 to 30% in people with diets containing adequate levels of zinc, but it can reach 80% in those with low levels of zinc in their diets or body tissues. Zinc is normally excreted in the urine and feces, with small amounts excreted in sweat. About 90% of what is retained is found in muscles and bones.



Primary organs affected when zinc is inhaled or ingested.

What Are the Primary Health Effects? Zinc is an essential element in our diet, but too little or too much can be harmful. Without enough dietary intake, people can experience a loss of appetite, decreased sense of taste and smell, decreased immune function, slow healing of wounds, and skin sores. Too little zinc can also result in poorly developed sex organs and retarded growth in young men. If pregnant women do not have enough zinc, babies might have growth retardation. Harmful effects from too much zinc generally begin at levels from 10 to 15 times higher than the recommended dietary allowances of 5, 12, and 15 mg per day for infants, women, and men, respectively. Eating large amounts of zinc can cause stomach cramps, nausea, and vomiting. Taking in large amounts of zinc over an extended period can cause anemia, damage the pancreas, and lower the levels of high-density lipoprotein cholesterol (the good form of cholesterol).

Breathing dust or fumes containing large amounts of zinc can cause a short-term disease called metal fume fever. This disease is an immune response affecting the lungs and body temperature. It is not known if there are health effects from breathing lower levels of zinc over long periods of time. It is also not known if high levels of zinc affect human reproduction or cause birth defects. However, infertility, low birth weight, and skin irritation have been observed in laboratory animals such as rats, guinea pigs, mice, and rabbits given high doses of zinc.

The U.S. Environmental Protection Agency (EPA) has stated that adequate information to evaluate the carcinogenicity of zinc is not available. However, no studies exist that indicate zinc causes cancer in humans.

Zinc deficiency may increase the toxic effects of arsenic, copper, cadmium and lead; thus an adequate amount of zinc can be considered protective against the toxicity of these elements. However, too much zinc can increase the absorption of lead, which has been shown to have an additive effect on the hematological effects of zinc.

What Is the Risk? The EPA has developed a toxicity value called a reference dose (RfD) *(see box below)* to estimate the risk of adverse health effects as a result of ingesting zinc. An RfD is an estimate of the highest dose that can be taken in every day without causing an adverse non-cancer effect. This toxicity value has been developed from clinical studies in humans given dietary supplements of zinc. To illustrate how the RfD is applied, a 150-pound (lb) person could safely ingest 21 mg of zinc every day without expecting any adverse effects (2.2 lbs = 1 kg, or 1,000 g, or 1 million mg).

Chemical Toxicity Value
Non-Cancer Effect: *Oral RfD*
0.3 mg/kg-day

What Are the Current Limits for Environmental Releases and Human Exposure? To help track facility releases to the environment, the Superfund amendments that address emergency planning and community right-to-know require the immediate reporting of a release of 1,000 lb (454 kg) or more of any zinc compound that occurs within 24 hours, and also require normal releases to be reported annually and entered into a nationwide Toxics Release Inventory. For drinking water, EPA has established a maximum contaminant level of 5 ppm for zinc and zinc compounds based on taste (not toxicity). The Occupational Safety and Health Administration (OSHA) has established a protective level of 1 milligram per cubic meter (mg/m^3) for zinc chloride fumes and a level of 5 mg/m^3 for zinc oxide fumes during an 8-hour workday over a 40-hour workweek. The National Institute for Occupational Safety and Health (NIOSH) has established the same standards for zinc and zinc chloride fumes for up to a 10-hour workday over a 40-hour workweek.

Where Can I Find More Information? More information on zinc can be found in the primary information source for this overview, the Toxicological Profile for Zinc prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) and available on the Internet at http://www.atsdr.cdc.gov/toxpro2.html. Other web-based sources of information include the ATSDR ToxFAQs (http://www.atsdr.cdc.gov/toxfaq.html), EPA's Integrated Risk Information System (http://www.epa.gov/iris/subst/index.html), and the Hazardous Substances Data Bank (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB).