Chromium

What Is It? Chromium is found naturally in rocks, soil, plants, and animals, including people. It occurs in combination with other elements as chromium salts, some of which are soluble in water. The pure metallic form rarely occurs naturally. Chromium does not evaporate, but it can be present in air as particles. Because it is an element, chromium does not degrade nor can it be destroyed.

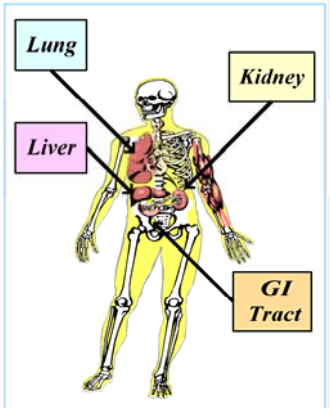
Symbol:	**Cr**
Atomic Number: *(protons in nucleus)*	**24**
Atomic Weight:	**52**

How Is It Used? Chromium is used to make steel and other alloys, for chrome plating, and as an additive to limit corrosion. Named for its colored compounds, chromium has also been used to make dyes and pigments for paints, and to make bricks in furnaces, tan leather, and preserve wood.

What's in the Environment? Chromium is present everywhere and can be found in three forms: metal ore, trivalent chromium (Cr III), and hexavalent chromium (Cr VI). The trivalent form occurs naturally in many fresh vegetables and fruits, meat, grains, and yeast. Relatively insoluble, it is the most prevalent form in surface soils where oxidation processes (which convert chromium from the hexavalent to trivalent form) are most common. Hexavalent chromium also occurs naturally, notably in water-saturated (reducing) conditions, and it is an indicator of human pollution. This form is relatively soluble and can move more readily through soil to groundwater. The concentration of naturally occurring chromium in U.S. soil ranges from 1 to 2,000 parts per million (ppm), with an average of 54 ppm. The concentration in sandy soil particles is estimated to be 70 times higher than in interstitial water (the water in the pore spaces between the particles), and concentration ratios are higher (e.g., 1,500) for clay soil. The typical ratio of chromium in plants to chromium in soil is estimated at 0.0045 (or 0.45%).

Chromium concentrations in air and water are very low. In air, concentrations generally range between 0.01 and 0.03 microgram per cubic meter ($\mu g/m^3$), and drinking water levels are generally less than 2 parts per billion (ppb). Absent information on the specific form, a general assumption often made for chromium that has been present in surface soil over time is that 10 to 17% of the total is in the hexavalent form. Groundwater can be contaminated at certain industrial facilities where sodium dichromate solutions (hexavalent) were used to prevent corrosion in piping. For groundwater, it is often assumed that most is hexavalent.

What Happens to It in the Body? Chromium can be taken in by breathing air, drinking water, or eating food. Children, and to a lesser extent adults, can also be exposed by ingesting soil. It can also be absorbed through the skin to a limited extent. Hexavalent chromium is more readily absorbed than trivalent chromium, regardless of the route of exposure. When air containing chromium is inhaled, chromium particles can be deposited in the lungs. Those deposited in the upper part of the lungs are usually coughed up and swallowed. Some that deposit deep in the lungs can dissolve, which allows chromium to pass through the lining of the lungs and enter the bloodstream. The finding of toxic effects following dermal exposure suggests that chromium is absorbed through the skin, although information on the percent absorbed is limited. Once in the bloodstream, chromium moves to all parts of the body. It is not metabolized, but hexavalent chromium is reduced by enzymatic reactions to trivalent chromium in the body. Inhaled chromium is excreted both in the urine and the feces. Ingestion of food is the major source of chromium exposure for most people in the United States. On average, adults take in an estimated 60 µg of trivalent chromium every day with their food. If taken in as hexavalent chromium, it is rapidly converted to the trivalent form after entering the stomach. When swallowed, most chromium leaves the body within a few days through the feces. A small amount – about 0.5% of Cr III and 10% of Cr VI – will pass through the lining of the intestines and enter the bloodstream. From there, chromium is distributed to all parts of the body. It then passes through the kidneys and is eliminated in the urine in a few days. The trivalent form in food can attach to other compounds that make it easier for chromium to be absorbed and enter the bloodstream from the stomach and intestines.



Primary organs affected when chromium is taken in through food, water, or air.

What Are the Primary Health Effects? The trivalent form of chromium is an essential nutrient in our diet and is needed for many important functions, including lipid, protein, and fat metabolism. Even at levels above those required to maintain health, it exhibits very low toxicity and it is not known to cause cancer. In contrast, hexavalent chromium can be toxic, including causing cancer if it is inhaled; the lethal dose is estimated at about 7- milligrams hexavalent chromium per kilogram (mg/kg) body weight. When inhaled, hexavalent chromium can damage the lining of the nose and throat, and irritate the lungs as well as the gastrointestinal tract. Nasal irritation has been observed following acute exposure at levels less than 0.01 mg/m^3. When swallowed, it can upset the stomach and damage the liver and kidneys. Some people have an allergic skin reaction after touching material containing chromium. Hexavalent chromium is one of a small set of chemicals the U.S. Environmental Protection Agency (EPA) has classified as a known human carcinogen, based on studies of workers in chromium processing factories who developed lung cancer after chronic inhalation exposures. However, hexavalent chromium does not cause cancer when ingested, most likely because it is rapidly converted to the trivalent form after entering the stomach. Information on joint toxicity with other chemicals is provided in the companion chemical mixtures fact sheet.

What Is the Risk? The EPA has developed toxicity values *(see box below)* to estimate the risk of getting cancer or experiencing other adverse health effects as a result of inhaling or ingesting chromium. The toxicity value for estimating the risk of getting cancer following inhalation exposure is called an inhalation unit risk (UR), which is an estimate of the chance that a person will get cancer from continuous exposure to a chemical in air at a unit concentration of 1 mg/m^3. A reference dose (RfD) is an estimate of the highest dose that can be taken in every day without causing an adverse non-cancer effect, and a reference concentration (RfC) is an estimate of the highest concentration in air that could be breathed every day without causing an adverse effect. These toxicity values have been developed by studying test animals given relatively high doses over their lifetimes, then adjusting those results to a mg/kg-day basis for humans, or directly from studies of humans exposed to chromium in the workplace. To illustrate, a 150-pound (lb) person could safely ingest 100 mg (about three ounces) of trivalent chromium or 0.2 mg of hexavalent chromium every day without expecting any adverse effects. Using the UR, EPA estimates that a person would have a one-in-a-million chance of developing cancer if continuously exposed for a lifetime to air containing 0.00008 $\mu g/m^3$ hexavalent chromium, as particulates.

Chemical Toxicity Values

Form of Chromium	Cancer Effect	Non-Cancer Effect	
	Inhalation UR	*Oral RfD*	*Inhalation RfC*
Cr III	None established	1.5 mg/kg-day	None established
Cr VI	12 per mg/m^3	0.003 mg/kg-day	0.0001 mg/m^3 *(as particulates)* 0.000008 mg/m^3 *(as chromic acid mists and dissolved Cr VI aerosols)*

What Are Current Limits for Environmental Releases and Human Exposures? 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 releases of 10 lb (4.54 kg) or more of chromic acid and 1,000 lb (454 kg) or more for all other regulated chromium compounds that occur within a 24-hour period, and also require normal releases to be reported annually and entered into a nationwide Toxics Release Inventory. The EPA has established a maximum contaminant level in drinking water of 0.1 ppm. The Occupational Safety and Health Administration has established protective levels of 0.5 and 1 mg/m^3 in air for water-soluble and -insoluble trivalent compounds, and 0.1 mg/m^3 for hexavalent compounds.

Where Can I Find More Information? More details can be found in the primary information source for this overview, the Toxicological Profile for Chromium, prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) and available 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 National Library of Medicine Hazardous Substances Data Bank (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB).