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U.S. Environmental Protection Agency

Radiation Information

Uranium

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The Basics

What is uranium?

Uranium (chemical symbol U) is a naturally-occurring radioactive element, with atomic number 92. Uranium is commonly found in very small amounts in rocks, soil, water, plants, and animals (including humans). Uranium is weakly radioactive and contributes to low levels of natural background radiation in the environment.

Who discovered uranium?

The use of uranium, in its natural oxide form, dates back to at least 79 A.D., when it was used to add color to ceramic glazes. The German chemist Martin Klaproth is credited with discovering uranium in samples of the mineral pitchblende in 1789. It was first isolated as a metal in 1841 by Eugene-Melchior Peligot. Uranium was discovered to be radioactive in 1896 by French physicist Henri Becquerel. Through his work with uranium metals, he was the first to discover the process of radioactivity.

Where does uranium come from?

Uranium is a naturally-occurring element

found at low levels in virtually all rock, soil, and water. Significant concentrations of uranium occur in some substances such as phosphate rock deposits, and minerals such as uraninite in uranium-rich ores. Because uranium has such a long radioactive half-life (4.47x109 years for U-238), the total amount of it on earth stays almost the same.

What are the properties of uranium?

When refined, uranium is a silvery white, weakly radioactive metal. Uranium metal has very high density, 65% more dense than lead. Uranium in ores can be extracted and chemically converted into uranium dioxide or other chemical forms usable in industry. Uranium found naturally has 3 different isotopes, U-238, U-235, and U-234. Other isotopes can be synthesized. All uranium isotopes are radioactive. The table below shows the percentage of natural abundance of each natural uranium isotope, and their respective half-lives.

Relative Abundance of Uranium Isotopes

Isotope	U-238	U-235	U-234
Natural Abundance (%)	99.27	0.72	0.0055
Half-life (years)	4.47 billion	700 million	246,000

Uranium isotopes can be separated to increase the concentration of one isotope relative to another. This process is called "enrichment." The enriched fraction has increased U-235. Uranium-235 is better for nuclear power reactors, and for making nuclear weapons. The process produces huge quantities of uranium that are depleted in U-235, but are almost pure U-238, called depleted uranium, or DU.

What is uranium used for?

Uranium metal is very dense and heavy. When it is depleted (DU), uranium is used by the military as shielding to protect Army tanks, and also in parts of bullets and missiles. The military also uses enriched uranium to power nuclear propelled Navy ships and submarines, and in nuclear weapons. Fuel used for Naval reactors is typically highly enriched in U-235 (the exact values are classified information). In nuclear weapons uranium is also highly enriched, usually over 90% (again, the exact values are classified information).

The main use of uranium in the civilian sector is to fuel commercial nuclear power plants, where fuel is typically enriched in U-235 to 2-3%. Depleted uranium is used in helicopters and airplanes as counter weights on certain wing parts. Other uses include ceramic glazes where small amounts of natural uranium (that is, not having gone through the enrichment process) may be added for color. Some lighting fixtures utilize uranium, as do some photographic chemicals. Phosphate fertilizers often contain high amounts of natural uranium, because the mineral material from which they are made is typically high in uranium. Also, people who collect rocks and minerals may have specimens of uranium minerals in their collection such as pitchblende, uraninite, autunite, uranophane, or coffinite.

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Exposure to Uranium

How does uranium get into the environment?

Uranium is present naturally in virtually all soil, rock and water. Uranium in soil and rocks is distributed throughout the environment by wind, rain and geologic processes. Rocks weather and break down to form soil, and soil can be washed by water and blown by wind, moving uranium into

streams and lakes, and ultimately settling out and reforming as rock. Uranium can also be removed and concentrated by people through mining and refining. These mining and refining processes produce wastes such as mill tailings which may be introduced back into the environment by wind and water if they are not properly controlled. Manufacturing of nuclear fuel, and other human activities also release uranium to the environment.

How does uranium change in the environment?

All uranium isotopes are radioactive. The three natural uranium isotopes found in the environment, U-234, U-235, and U-238, undergo radioactive decay by emission of an alpha particle accompanied by weak gamma radiation. The dominant isotope, U-238, forms a long series of decay products that includes the key radionuclides radium-226, and radon-222. The decay process continues until a stable, non-radioactive decay product is formed (see uranium decay series). The release of radiation during the decay process raises health concerns.

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Exposure to Uranium

How do people come in contact with uranium?

A person can be exposed to uranium by inhaling dust in air, or ingesting water and food. The general population is exposed to uranium primarily through food and water. The average daily intake of uranium from food ranges from 0.07 to 1.1 micrograms per day. The amount of uranium in air is usually very small. People who live near federal government facilities that made or tested nuclear weapons, or facilities that mine or process uranium ore or enrich uranium for reactor fuel, may have increased exposure to uranium.

How does uranium get into the body?

Uranium can enter the body when it is inhaled or swallowed, or under rare circumstances it may enter through cuts in the skin. Uranium does not absorb through the skin, and alpha particles released by uranium cannot penetrate the skin, so uranium that is outside the body is much less harmful than it would be if it where inhaled or swallowed. When uranium gets inside the body it can lead to cancer or kidney damage.

What does uranium do once it gets into the body?

About 99 percent of the uranium ingested in food or water will leave a person's body in the feces, and the remainder will enter the blood. Most of this absorbed uranium will be removed by the kidneys and excreted in the urine within a few days. A small amount of the uranium in the bloodstream will deposit in a person's bones, where it will remain for years.

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Health Effects of Uranium

How can uranium affect people's health?

The greatest health risk from large intakes of uranium is toxic damage to the kidneys, because, in addition to being weakly radioactive, uranium is a toxic metal. Uranium exposure also increases your risk of getting cancer due to its radioactivity. Since uranium tends to concentrate in specific locations in the body, risk of cancer of the bone, liver cancer, and blood diseases (such as leukemia) are increased. Inhaled uranium increases the risk of lung cancer.

Is there a medical test to determine exposure to uranium?

Tests are available to measure the amount of uranium in a urine or stool sample. Hospitals do not perform these tests routinely. These tests are useful if a person is exposed to a large amount of uranium, because most uranium leaves the body in the feces within a few days after ingestion. Uranium can be found in the urine for up to several months after exposure. However, the amount of uranium in the urine and feces does not always accurately show the level of uranium to which you may have been exposed. Since uranium is known to cause kidney damage, special urine tests are often used to determine whether kidney damage has occurred.

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Protecting People from Uranium

What can I do to protect myself and my family from uranium?

Most people are not exposed to dangerous levels of uranium. However, people who live near uranium mining areas, or near government weapons facilities or certain industrial facilities may have increased exposure to uranium, especially if their water is from a private well. Analytical laboratories can test water for uranium content. Occasionally, household wares may be found with uranium in them, such as some older ceramic dishes or plates in which uranium was used in the glaze. These generally do not pose serious health risks, but may nevertheless be retired from use as a prudent avoidance measure. A radiation counter is required to confirm if ceramics contain uranium.

How do I know I'm near uranium?

You need specialized equipment and training

to detect uranium in the environment.

What is EPA doing about uranium?

EPA standards under the Clean Air Act limit uranium in the air. The maximum dose to an individual from uranium in the air is 10 millirem. The cleanup of contaminated sites to be released for public use, must meet EPA's risk-based criteria for soil and ground water. EPA's site cleanup standards limit a person's increased chance of developing cancer to between 1 in 10,000 to 1 in 1,000,000 from residual uranium on the ground. Site-specific factors, cost, and community concerns are weighed in establishing the actual clean up value.

Uranium in drinking water is covered under the Safe Drinking Water Act. This law establishes Maximum Contaminant Levels, or MCLs, for radionuclides and other contaminants in drinking water. The uranium limit is 30 µg/l (micrograms per liter) in drinking water.

EPA has issued special regulations for cleaning up uranium mill tailing sites under the "Uranium Mill Tailings Radiation Control Act." The regulations are found in 40CFR192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings." Exit EPA

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