

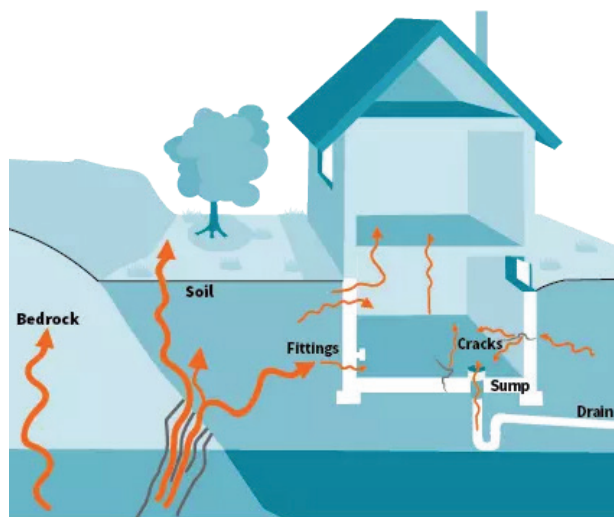
# Health Risks Associated with Uranium and its Radioactive Decay Chain

People living near where there are higher than normal concentrations of uranium in exposed rock or in their drinking water are more likely to come into contact with this element, as well as other radioactive decay-chain elements, including radon gas.

## Radon gas in your basement

Radon is an invisible radioactive gas that is produced from the natural radioactive decay of uranium. It cannot be smelled, seen or tasted. It comes up from the ground and is in every home in Canada, sometimes at levels known to be harmful. It is easy to test for, and with proper ventilation, can be often reduced to safe levels.

Radon gas is much heavier than air and enters buildings through the foundation and basement floor, so test for this gas in your basement. The level of radioactivity due to radon is measured in *becquerels*. For instance, a room having 200 becquerels of radon per cubic meter of air ( $200 \text{ Bq/m}^3$ ) has 200 atoms decaying every second in every cubic meter of air inside the room.



The Canadian Radon Guideline recommends that when  $200 \text{ Bq/m}^3$  or higher is measured inside a home, the air should be ventilated to minimize the concentration of this radioactive gas. The United States Environmental Protection Agency (EPA) recommends homes be fixed if the radon gas level is 4 pCi/L (picocuries per liter) or  $148 \text{ Bq/m}^3$ . The EPA goes on to advise that with mitigation radon levels in homes can be reduced to 2 pCi/L or  $74 \text{ Bq/m}^3$ . The World Health Organization recommends a level for radon of  $100 \text{ Bq/m}^3$ .

## Is radon gas harmful?

Exposure to high levels of radioactive radon gas in indoor air results in an increased risk of developing lung cancer. Among non-smokers, it is the number one cause of lung cancer. For those who smoke, the risk of developing lung cancer increases even further if they are exposed to high radon levels.

Radon does not stay as radon gas. It decays with a half-life of approximately four days and follows the decay-chain series through the sequence of seven other isotopes. A burst of radiation is emitted at each stage of decay, until it ultimately becomes non-radioactive lead (see attached brochure for details). These other radioactive substances can adhere to dust particles or float in the air, and if inhaled, can deliver a dose of radiation directly into the lungs.

## Measuring radon gas

Radon gas levels in homes fluctuate throughout the seasons, with higher levels usually in the fall and winter when the windows are closed. Health Canada recommends that homeowners do at least one long-term radon test for three months. Radon gas detectors are available online or at local hardware stores.

If radon gas levels are above the Canadian guideline of  $200 \text{ Bq/m}^3$ , Health Canada recommends hiring a professional who is certified under the Canadian National Radon Proficiency Program ([www.c-nrpp.ca](http://www.c-nrpp.ca)). An article in the November 7, 2023 issue of the *Lanark Era* by the Leeds, Grenville and Lanark District Health Unit points out that lowering radon levels in a home requires specific technical knowledge and skills to ensure the job is done properly.

## Uranium in drinking water

If you suspect your drinking water might have elevated levels of uranium, have your water tested, particularly if your source of drinking water is a well. The deeper the well, the more likely it will contain traces of uranium that may be in the bedrock.

The provisional guideline value for uranium in drinking water by the World Health Organization is thirty micrograms per liter ( $30 \mu\text{g/L}$ ). The United States Environmental Protection Agency has the same recommended level –  $30 \mu\text{g/L}$ . In Canada, the maximum acceptable concentration for uranium in drinking water is  $20 \mu\text{g/L}$ . Another way to express this is 0.02 milligrams per litre (mg/L).

Caduceon Environmental Laboratories in Ottawa, Ontario can test drinking water or soil for the presence of uranium and other heavy metals, including thallium and lead. Their unit of measurement for uranium is milligrams per litre (mg/L).

### What are the health risks from exposure to uranium?

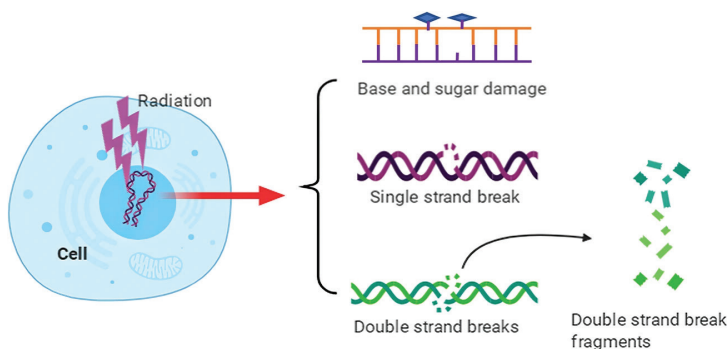
As long as naturally occurring uranium remains outside the body, it poses little health risk. However, if uranium is inhaled or ingested in significant amounts, its radioactivity can initiate the development of lung cancer and bone cancer. People are generally urged to exercise extreme caution in handling, carrying and storing radioactive rocks, and to avoid letting children handle them. Careful hand washing is essential.

For the most part, food and drinking water are the two main sources of ingested uranium. Most of the inhaled and ingested uranium is not absorbed, does not enter the bloodstream and leaves the body in the feces within a few days. According to the Public Health Statement by the United States Agency for Toxic Substances and Disease Registry, only about 0.1 to 6 percent of the uranium a person ingests will get into the bloodstream through the digestive tract (mouth, stomach, intestines). Uranium compounds dissolved in water enter the bloodstream more readily than uranium compounds that are poorly soluble.

### How does radiation affect cells and cell division?

Even the tiniest exposure to radiation—a gamma ray, or alpha or beta particle, given off when a radioactive atom decays—can damage a gene, our basic unit of heredity. Each person has two copies of each gene, one inherited from each parent. Genes are encoded on DNA (deoxyribonucleic acid) that contains the genetic information for the development and function of cells and whole organisms.

Gamma rays can penetrate tissue and usually cause damage at a single point. Alpha particles are larger and bulky, and once inside the body can damage both strands of the DNA double helix at once, sometimes causing segments to fall apart. Beta particles are high-energy, high-speed electrons that are ejected from the nucleus by some radioisotopes during radioactive decay.



Cells can repair certain types of damage with the help of DNA-repair enzymes, if they do this repair before the next cell division. If repair is not done on time, or if the DNA is repaired incorrectly, the error becomes part of the cell's genetic makeup, and this flaw is reproduced faithfully from there on.

Some types of damage, particularly alpha particle damage, are difficult or impossible to repair. When the cell tries to divide with this damage, one or both of the newly formed cells may die. If it dies,

this gets rid of the damage. In fact, reproductive failure, either at the cell level or at the whole-organism level, is a major way nature gets rid of radiation damage.

Some cells with minor damage that has not been repaired or has been repaired incorrectly can survive cell division. These cells are not fully normal and give rise to a slowly increasing group of abnormal cells. This is one way cancers can start. Remember that radiation is not the only way cancer can start.

Radiation can damage any part of any gene. Radiation damage is hard to track because it can take so many forms, and it can hide for generations before it manifests.

Humans, like all other organisms on this planet, have evolved to deal with a certain level of background radiation. Excess exposure, even a fraction of the background level, can change the balance in favour of the accumulation of genetic defects, rather than repair and elimination. Ongoing exposures, such as exposure to uranium and all its decay products found in contaminated construction materials or radioactive residues left in public places, are often unrecognized hazards.

Helpful websites: <https://www.atsdr.cdc.gov/csem/radon/radon.pdf>  
<https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-uranium.html>