



Radionuclides in Ecosystems

Radioactive elements are part of our ecosystem, part of the air we breathe, the water we drink and the food we eat.

- Radionuclides can occur naturally, or can be man-made.
- Over half of the average annual radiation exposure of people in the U.S. comes from natural sources.

About Radionuclides in Ecosystems

An ecosystem is a place with a one-of-a-kind combination of air, water and land. An ecosystem has habitats that support plant and animal life. Ecosystem science focuses on all parts of the system, including the interaction among the water, air, land, plants, humans and other animals. Ecosystem science can tell us how minerals and other chemicals in nature (including radionuclides) move through Earth's different natural systems.

Radionuclides enter an ecosystem in three ways:

- As minerals present in Earth's original crust.
- As radionuclides created by cosmic rays hitting atoms in Earth's atmosphere.
- From human activity.

RADIONUCLIDES IN EARTH'S CRUST

Some radionuclides have been present in rocks since the formation of Earth. Others are their decay products. Examples of these natural radionuclides include potassium-40, rubidium-87, uranium and thorium and decay products, such as radium and radon.

These radionuclides end up naturally in soil, water and air. Rocks containing them are broken down into soil by the weather, bacteria and fungi. When radionuclides are in soil particles, they can be blown around by wind. Some will dissolve in water and end up in surface or ground water. Some radionuclides dissolve more easily than others. Also, the makeup of the water affects how much of the radionuclide will dissolve.

More than half of the average annual radiation exposure of people in the U.S. comes from natural sources. The natural radionuclide, radonⁱ, is the single biggest natural source of exposure. It comes from the breakdown of radium. Breathing indoor air containing radon is the most common exposure route.

Radon is one radionuclide that dissolves easily in water. Radon concentration in water is usually low enough that they are not a serious health threat. You can learn more about radium and radon in water on EPA's Radon in Drinking Waterⁱⁱ webpage.

RADIATION FROM SPACE

Cosmic rays come from stars, our sun, other stars and exploding stars. The rays continuously strike atoms in Earth's atmosphere. The atmosphere stops most of the cosmic rays, however, the collisions leave some atoms unstable (radioactive). These radioactive atoms are called cosmogenic radionuclides. They are rare, but some

of them do reach Earth's surface and settle on the soil and water. Cosmic radiation is the main source of carbon-14, which is used to date ancient artifacts.

RADIONUCLIDES FROM HUMAN USES OF RADIOACTIVE MATERIAL

Nature is the major source of radionuclides in an ecosystem. Much smaller amounts of radionuclides come from sources developed by humans. Examples include uranium mines, nuclear power plants and research facilities that use radionuclides. However, for most people the annual exposure from these sources is very low. Only in certain areas where there are open uranium and other mineral mines and mining wastes present is there a serious health hazard.

- **Nuclear Weapons Testing:** Mostly in the 1950s and 1960's, nuclear weapons tests released large amounts of radionuclides that spread and remained in ecosystems until the radionuclides decayed away. The last nuclear weapons test occurred in 1980, and most of the radionuclides, such as strontium-90, have decayed away. Today, nuclear events include nuclear accidents and potentially terrorist acts.
- **Nuclear Facility Releases:** The small amounts of airborne radionuclides released from facilities that handle and process radioactive materials can get into the soil, water or air. The facilities operating permits allow only very small releases because they result in very small exposures.
- **Radioactive Waste:** Improper disposal of radioactive waste is another way radionuclides can enter an ecosystem. For example, water seeping through mining wastes can dissolve some radionuclides and carry them into the water system. Public water systems are monitored carefully to make sure the drinking water is safe. This kind of waste accounts for less than a tenth of one percent of the average annual radiation exposure of Americans.

You can learn more about all of the different sources of radiation exposure at EPA's RadTown websiteⁱⁱⁱ.

Rules and Guidance

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA's RadNet^{iv} monitoring system is a national network of monitoring stations that regularly collect air, precipitation, drinking water, and milk samples for analysis of radioactivity. EPA also develops standards for disposal of nuclear waste and in some cases, oversees the disposal of radioactive material. EPA's National Emissions Standards for Hazardous Air Pollutants for Radionuclides (RadNESHAPs)^v sets regulatory limits for radionuclide emissions from industrial sources.

U.S. DEPARTMENT OF AGRICULTURE (USDA)

USDA works with the U.S. Geological Service and U.S. Fish and Wildlife Service to ensure that radioactive materials are disposed in places that prevent the radioactive material from ever entering the food chain.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES (HHS), U.S. FOOD AND DRUG ADMINISTRATION (FDA)

FDA monitors naturally occurring and man-made radionuclides in food as part of its Total Diet Studies^{vi}. FDA establishes guidelines for preventing and addressing potentially contaminated crops and livestock during a radiological emergency.

U.S. DEPARTMENT OF ENERGY (DOE)

DOE's Department of Environmental Management issues regulations related to spills, releases, and cleanup of radiation in the soil on and around DOE facilities. DOE requires its facilities to limit how much radiation may be released based on EPA's standards, and it ensures that all facility operators comply with these standards.

THE STATES

The States have different programs relating to the protection of soil, crops and livestock. States apply EPA's Protective Action Guides in the event of a radiological emergency. Some states have created more stringent standards for disposal of radioactive material than the federal limits established by EPA.

What you can do

In most cases no special precautions are necessary.

If you use water from a private well, you should get your water tested for radionuclides.

It's important to test your home for radon. Testing at home is easy. There are many kinds of low-cost radon test kits available by phone, online and in many stores. If you prefer, you can hire a professional to do the testing. For more information about radon, its risk and what you can do to protect yourself, visit EPA's Radon Website^{vii}.

In a radiological emergency where food contamination may be an issue, listen for advisories from federal, state or local public health officials. Common food handling safety actions can be taken to reduce the amount of radioactive contamination in or on food such as washing, brushing or peeling the surface of the fruits or vegetables.

Where to learn more

You can learn more about radionuclides in ecosystems by visiting the resources available on the following webpage: <http://www3.epa.gov/radtown/ecosystems.html#learn-more>.

ⁱ <http://www2.epa.gov/radon/>

ⁱⁱ <http://www2.epa.gov/radon/rnwater.html>

ⁱⁱⁱ <http://www3.epa.gov/radtown>

^{iv} <http://www2.epa.gov/radnet/>

^v <http://www2.epa.gov/radiation/neshaps/>

^{vi} <http://www.fda.gov/Food/FoodScienceResearch/TotalDietStudy/default.htm>

^{vii} <http://www2.epa.gov/radon/>