

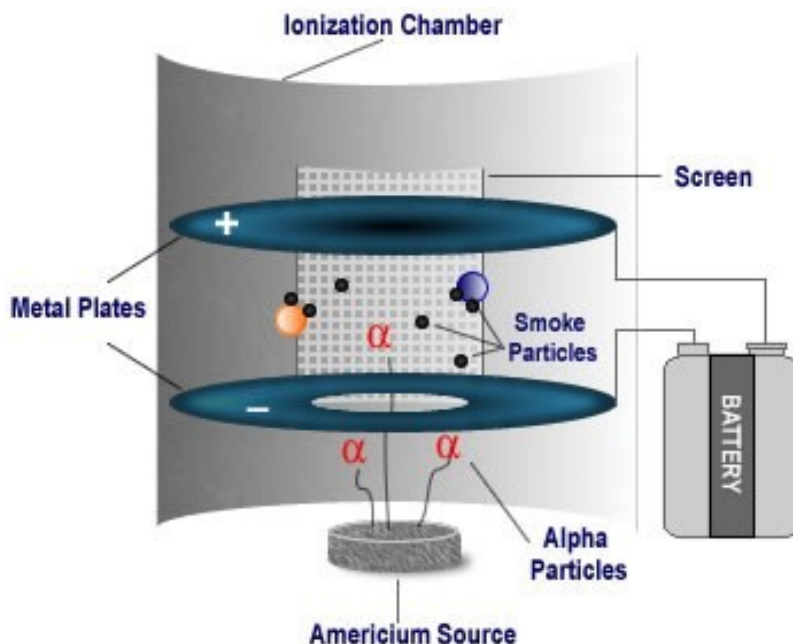
What's in your home?

We are surrounded by numerous sources of radiation in our everyday life. Human life has been subjected to radiation from background and other sources ever since it came into existence. We cannot escape radiation.

There is a mysterious aura surrounding the concept of radiation. We cannot see radiation, neither can we feel it and therefore it is extremely important to understand it. It is now time we make ourselves well aware of all these sources of radiation to remove any myths about the dangers posed by radiation.

Smoke detectors

Most smoke detectors use a small amount (about 1.0 microCurie) of Americium-241 (^{241}Am), a radioactive material to detect smoke. ^{241}Am is an alpha-emitting radioactive source i.e., it decays by emitting alpha (helium-4) particles.



[Image adopted from the NRC website]

A typical smoke detector has three major components – the ionization chamber, a radioactive source and a battery. The ionization chamber consists of two metal plates held at different voltages. The ^{241}Am source emits alpha particles that interact with the air molecules in between the two plates. This interaction causes the air molecules to ionize i.e., it breaks down to positive and negative ions which are then attracted to the negative and positive plates respectively. This flow of charges results in an electric current.

If there is smoke in the air, the smoke particles stick to the ionized air molecules and obstructs their flow to the metal plates. This obstruction leads to a decrease in the electric current. It is this decrease in current which is detected and triggers the smoke alarm.

Modern smoke detectors emit around 37,000 alpha particles per second. However, the americium is encased in ceramic and foil and therefore very few of them can exit the detector. The energy of the

alpha emitted by ^{241}Am is about 5.4 MeV, which can be stopped by a piece of paper or a few centimeters of air and cannot penetrate the human skin. Unless directly inhaled or ingested, ^{241}Am in the smoke detector does not pose any threat.

The U.S. National Council on Radiation Protection and Measurements estimates an annual radiation dose of 9-50 nanosievert from household smoke detectors which is negligible as compared to 3.6 millisievert which is the radiation dose received by a typical person in the United States from natural and other man-made sources. [With inputs from A. G. Hutchinson and F. I. Hutchinson, "Radioactivity in Everyday Life," *Journal of Chemical Education* **74**, 501 (1997).]

Building Materials and Soil

Sandstone, brick, concrete, gypsum and granite contain naturally occurring radioactive elements like radium, uranium and thorium and act as sources of radiation. Radiation dose from building materials largely depend on the type and amounts of material used. However, the level of radioactive materials in such building materials is very low and does not pose any threat to human health. Living in a concrete building adds only up to 7 millirem per year to the annual radiation dose of a person.

Drinking water

Drinking water in our homes usually come from rivers and lakes. Radiation can enter the water stream from natural sources rocks and soil. In the United States, the levels of radiation in drinking water is very low. The average annual radiation dose received by a person in the U.S. is about 5 millirem.

Television

If you still use your old television set, the cathode ray tube in the machine exposes you to about 1 millirem of X-ray radiation per year. The FDA monitors all TV sets sold in the U.S. to be tested to make sure they do not exceed a safe level of X-ray emission. Flat-screen TVs and computers don't use cathode ray tubes, so they don't produce X-rays.

Sitting next to a person

Just by sitting next to a person would expose you to radioactivity arising from the internal radiation emitted from that person's body. All living beings on Earth have Potassium-40, Carbon-14 and Lead-210 in them from the time of their birth. These may arise due to the consumption of food, drinking water or simply inhaling air containing radioactive elements. These elements are absorbed by the tissues and bones in our bodies and keep getting replenished over time by simple processes like ingestion and inhalation. The radiation received via this process is called Internal radiation.

The exposure received by an average man in the United States by Internal radiation is an effective dose of about 0.03 rem each year.

Accumulation of radon in basements

Radon is a radioactive gas that is the decay product of Uranium and Thorium. Since both uranium and thorium are found in rocks and soil in small quantities, radon is released in the environment from these sources. Radon does not have any smell or taste but can create problems due to its radioactive nature. Radon can enter buildings or houses through openings in floors, walls or through construction joints

and can get trapped if enough air circulation is not possible. Hence, radon accumulation mostly occurs in basements and enclosed spaces within buildings.

The average dose received by a person from radon in the atmosphere is 200 millirem. Radon poisoning accelerates if the person is a smoker. To read about the dangers of radon for smokers, read [Smoking kills...it really does!](#)

Radon is the second leading cause of lung cancer in the United States. More than 21,000 Americans die each year from radon-related lung cancer [Statistics from the United States Environment Protection Agency (EPA) website]. Ensuring proper ventilation and sealing floor and foundation wall cracks can help to maintain the radon levels in the basements at a controlled level so that it does not pose any danger to human health.