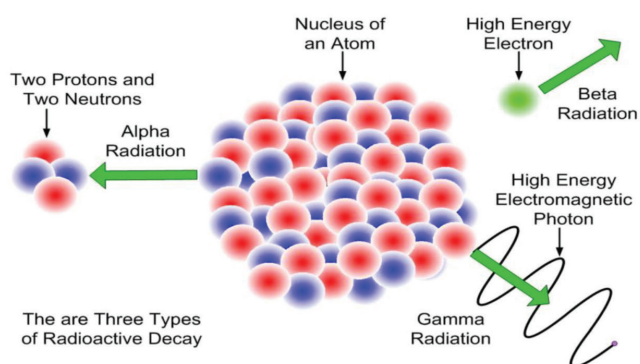


# Radioactivity in the Environment

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The spontaneous emission of energetic alpha, beta and gamma particles from any material is known as radioactive emission and the materials which emit these particles are known as radioactive materials. This phenomenon of emission of particles from any material is called radioactive decay. In 1850s, Niepce de Saint-Victor was trying to develop color photograph, using light-sensitive metal salts. Niepce de Saint-Victor observed that, even in complete darkness, certain salts could expose photographic emulsions. He soon realized that Uranium salts were responsible for this anomalous phenomenon. By 1861, Niepce stated frankly that Uranium salts emitted some sort of radiation that was invisible to the human eyes. But it was soon forgotten. Then in 1896, French scientist Henry Becquerel discovered Radioactivity while working on phosphorescent material. These materials produce phosphorescence when exposed to light. The emitted radiations were given the name "Becquerel Rays". On the basis of various experiments, it was concluded that uranium emits the rays like X-rays. Later in 1898, Pierre and Marrie Curie discovered two new substances named Polonium ( $^{210}\text{Po}$ ) and radium ( $^{226}\text{Ra}$ ). About 20 such elements were known by 1904 and 30 by 1912. At present thousands of artificial and naturally occurring radioactive species are known to exist. Radioactivity can be measured in three units, that are, Curie (Ci), Rutherford (Rd) and Becquerel (Bq). Among these units Becquerel (Bq) is the SI unit.



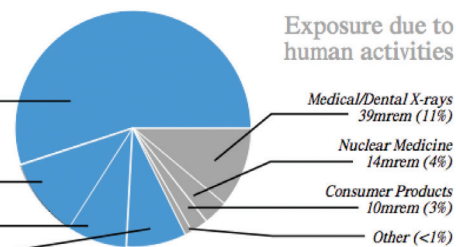
## Sources of Radiation

The exposure of human beings to ionizing radiation from natural sources is a continuing and inescapable feature of life on earth. There are two main contributors to natural radiation exposure: high energy cosmic ray particles incident on earth's atmosphere and radionuclide that originated in the earth's crust and are present everywhere in environment, including human environment. The artificial sources of radiation include discharges from nuclear and thermal power plants, contaminated articles from radiotherapy and other departments in hospitals. The maximum amount of radiation received to human beings is due to the background radiation

causes due to the presence of radioactive element in the earth crust.

## Exposure due to natural sources

Radon 200mrem (55%)  
Inside Human Body 40mrem (11%)  
Rocks & Soil 28mrem (8%)  
Cosmic 27mrem (8%)



## Radioactive elements in nature:

Earth contains trace amount of radioactive elements distributed inside it. These radioactive elements are uranium, thorium and potassium isotopes. These radioisotopes in geological domain mainly depend on the uranium and thorium distribution. These unstable radionuclides are mostly isotopes of heavy elements, which continuously decay emitting alpha, beta and gamma radiation in indoor and outdoor environment until they reach to a stable condition.

- 1. Uranium:** Uranium is the heaviest trace element found in all terrestrial substances at varying level of concentration. Uranium is a chemical element with symbol "U" and atomic number 92. Uranium is weakly radioactive because all its isotopes are unstable. In 1789, Martin Heinrich Klaproth published his research paper with discovery of Uranium as mineral named pitchblende. Later in 1896, Uranium was used by Henry Becquerel for the discovery of radioactivity.
- 2. Radium:** The radiogenic isotope, radium ( $^{226}\text{Ra}$ ), is a naturally occurring radioactive metal formed by the decay of uranium and thorium in the environment. It occurs at low virtually in all rock, soil, water, plants and animals. It has high radio-toxicity and affinity to accumulate in bones, when ingested. Radium is readily absorbed by clay minerals. Radium isotopes can be continuously released to groundwater by alpha decay of radium and daughter then through recoil mechanism from mineral surfaces. It is more soluble in water than uranium and thorium, may leach from soils, rocks, and mine wastes and readily mobilized into ground and surface water.
- 3. Radon:** Radon, being a member of noble gas family, originates from radioactive decay of Uranium-238 and Radium-226 (uranium-radium-radon). Radon is a radioactive noble gas that generally lacks activity towards other chemical agents. Radon is colourless, odourless, inert, water soluble and the heaviest rare gas occurring in the nature under standard temperature and pressure conditions. Radon belongs to the family of

noble gases in the periodic table and is the only element in the series, which exist in the gaseous state. Estimation of decay products of radon and thoron is very important from radiation point of view. This is because the dose received by human beings is predominantly contributed by the decay products of radon and thoron and not due to radon and thoron gases.

These radioactive elements occur in the earth crust and they are free to move through soil pores and rock fractures; then to escape into the atmosphere due to various factors like difference in pressure and diffusion. Radon gas migrates into the houses through cracks and openings in the foundation and diffuses from the soil through the concrete floor henceforth accumulate in the indoor environment in sufficient quantities to pose a health hazard.

**Health hazard due to these radioactive elements:**

The major contribution to the radiation doses received is

due to the inhalation of radon, thoron and their progeny. Out of these all, radon and its progeny are responsible for the significant dose received in enclosed areas like underground mines, caves, cellars and poorly ventilated houses. The radon hazard does not come primarily from radon itself, but rather from its daughter products, which readily attach themselves to tiny dust particles in the indoor air and occur as a mixture of attached and unattached fraction. Due to electrostatic attraction, it is very easy for the daughters to attach themselves to the aerosol particles. The main health problem arises when these daughter elements reach to the tissues of the lungs. Inhalation of radon or more specially their daughters leads to deposition of radioactive atoms on the wall of the lung, especially in the bronchial region. In the decay of these atoms, alpha particles are emitted, which irradiate the cells of the lung tissue through which they pass. These irradiated cells may become cancerous and causes lungs cancers.

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