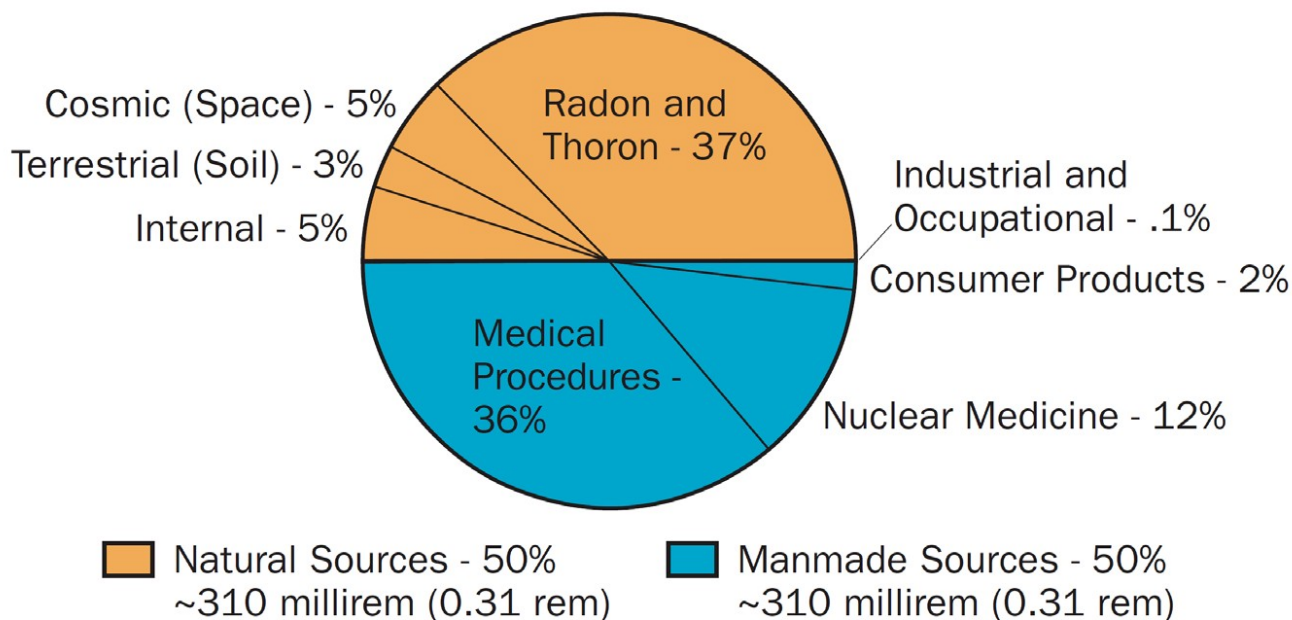


“Radiation has existed everywhere in the environment since the Earth's formation--in rocks, soil, water, and plants. The mining and processing of naturally occurring radioactive materials for use in medicine, power generation, consumer products, and industry inevitably generate emissions and waste. Recognizing the potential hazards of these activities, Congress designated EPA as the primary federal agency charged with protecting people and the environment from harmful and avoidable exposure to radiation” (<http://www.epa.gov/radiation/basic/index.html>). The National Cancer Institute has just released a fact sheet about accidents at nuclear plants and cancer risks. <http://www.cancer.gov/cancertopics/factsheet/Risk/nuclear-power-accidents>

**Nonionizing Radiation: what are the advantages?** With microwave radiation, common tasks such as heating food and telecommunications occur. With infrared radiation, lamps keep food warm in restaurants. Broadcasting occurs through radio waves. <http://www.epa.gov/radiation/understand/index.html> gives an illustration of the spectrum of nonionizing radiation.

Sources of radiation come from natural, medical, nuclear, and consumer products. Below is the 2009 report from the National Council on Radiation Protection and Measurements. [http://www.ncrponline.org/Publications/Statements/Statement\\_10.pdf](http://www.ncrponline.org/Publications/Statements/Statement_10.pdf)



Source: NCRP Report No.160(2009)

Radiation used in medicine (diagnostic x-rays, cancer treatments and radiopharmaceuticals) is largest source of man-made radiation to which people in the United States are exposed.

**Ionizing radiation: alpha and beta particles, gamma rays and x-rays.** Alpha, Beta, and Gamma rays come from natural sources or can be technologically produced. Most of the x-rays people receive are technologically produced. **Alpha Particles** usually are completely absorbed by outer dead layer of human skin, are not a hazard outside the body, can be harmful if ingested or inhaled, and can be stopped by a sheet of paper. Humans are exposed to **Beta Particles** from man-made and natural sources (e.g., tritium, carbon-14 and Strontium-90. Some are capable of penetrating the skin and causing damage; they can be reduced or stopped by clothing or a few mm of substance (e.g., aluminum); and they are generally more hazardous when inhaled or ingested. **Gamma Rays** are very penetrating, are natural (potassium-40), are manmade (plutonium-239, Cesium-137), easily pass through the human body or are absorbed by body tissue, and are a hazard for the entire body. Several feet of concrete or a few inches of lead may be

required to stop energetic gamma rays. **X-Rays** essentially have the same properties as Gamma rays but differ in origin; are generally lower in energy, therefore less penetrating than Gamma rays; and a few mm of lead can stop penetration of medical x-rays.

**How can alpha particles affect people's health?** The health effects of alpha particles depend heavily upon how exposure takes place. External exposure (external to the body) is of far less concern than internal exposure, because alpha particles lack the energy to penetrate the outer dead layer of skin. However, if alpha emitters have been inhaled, ingested (swallowed), or absorbed into the blood stream, sensitive living tissue can be exposed to alpha radiation. The resulting biological damage increases the risk of cancer; in particular, alpha radiation is known to cause lung cancer in humans when alpha emitters are inhaled. The greatest exposure to alpha radiation for average citizens comes from the inhalation of [radon](#) and its decay products, several of which also emit potent alpha radiation.

**How can beta particles affect people's health?** Acute exposure is said to be uncommon. Chronic exposure occurs when low-level exposures occur over a long period of time (e.g., 5 to 30 years). Iodine-131 concentrates in the thyroid gland, increasing the risk of thyroid cancer. Strontium-90 accumulates in bone and teeth, causing damage to teeth and increasing the risk of bone cancer.

**How can gamma particles affect people's health?** "Because of the gamma ray's penetrating power and ability to travel great distances, it is considered the primary hazard to the general population during most radiological emergencies." "Radiation Sickness" is a term used when exposure occurs in the public arena. "Both direct (external) and internal exposure to gamma rays or X-rays are of concern. Gamma rays can travel much farther than alpha or beta particles and have enough energy to pass entirely through the body, potentially exposing all organs." "X-ray exposure of the public is almost always in the controlled environment of dental and medical procedures" (U.S. Environmental Protection Agency).

Results of exposure to radiation affect people by depositing energy in body tissue, which can cause cell damage or cell death. The DNA (genetic material) is damaged. This can cause harmful genetic mutations that can be passed on to future generations. Exposure to large amounts can cause sickness in a few hours or days and death within 60 days of exposure. When the DNA of cells is damaged, the chance of cancer is increased. The extent of damage depends upon amount of energy absorbed, the time period and dose rate of exposure, and the particular body organ exposed. For example, a minimum time period between exposure and appearance of leukemia (cancer of the white cells) is two years. For solid tumors (e.g., carcinoma of lungs, breast, prostate), the latency period is more than five years.

Additional information for the consumer about alpha, beta and gamma rays can be found at:

<http://www.epa.gov/rpdweb00/understand/alpha.html#affecthealth>

<http://www.epa.gov/rpdweb00/understand/beta.html>

<http://www.epa.gov/rpdweb00/understand/gamma.html#affecthealth>

Know the symbols for protecting oneself from radiation exposure!

<http://www.epa.gov/rpdweb00/understand/symbols.html>

United Nations Symbol (adopted in 2007)

