



What is Radiation?

This leaflet answers key questions about radiation: what is radiation, how does radiation affect people and how are we exposed to radiation? Radiation refers to the transfer of energy from one place to another.

There are two types of radiation:

- **non-ionising radiation**, such as visible light, signals from mobile phones and radio waves
- **ionising radiation**, such as radiation emissions from uranium ore and high frequency waves in the electromagnetic spectrum (eg X-rays)

Each type of ionising radiation is capable of disrupting stable atoms and causing them to have an imbalance of charge (ionisation). This can cause chemical changes in living matter which may cause harm to people's health, depending on the radiation dose received.

What is Ionising Radiation?

Unstable atoms in a material are said to 'decay' giving out ionising radiation in the process. The property of a material to decay and emit ionising radiation is called **radioactivity** and the material is said to be **radioactive**. As the unstable atoms in a radioactive material decay the atoms change to another form. The time taken for half the unstable atoms in a material to decay and change is known as the half-life. Each radioactive material has its own half-life. These vary from less than a few seconds to more than thousands of years.

There are three main types of ionising radiation: alpha (α), beta (β) and gamma (γ). Alpha and beta radiations are particles, while gamma radiation is a wave similar to X-rays. These forms of radiation differ in their ability to penetrate into the body or other materials and also in their ability to cause harm to people.

Alpha particles As they are relatively big, heavy and slow, alpha particles are not able to penetrate very far through materials. They are stopped by a few centimetres of air or a sheet of paper and even by the dead layer of skin on the outside of our bodies. As they usually cannot penetrate into the body, alpha particles do not pose a significant hazard from outside the body. However, radioactive materials emitting alpha particles can get into the body by inhalation, ingestion or through open wounds. They can then damage tissue and have a greater potential to cause cancer than beta particles and gamma rays.

Beta particles These are relatively light, small and fast, so they may travel several metres in air and can penetrate through exposed skin. Consequently, beta particles can present a hazard from inside or outside the body. They can be stopped by thin sheets of aluminium or perspex.

Gamma rays These rays have no weight and can penetrate through the body, depositing some of their energy on the way and so causing harm. Gamma rays are therefore a hazard both inside and outside the body. They can be stopped or exposure can be reduced by the use of thick, heavy shielding.

How Radiation Affects People

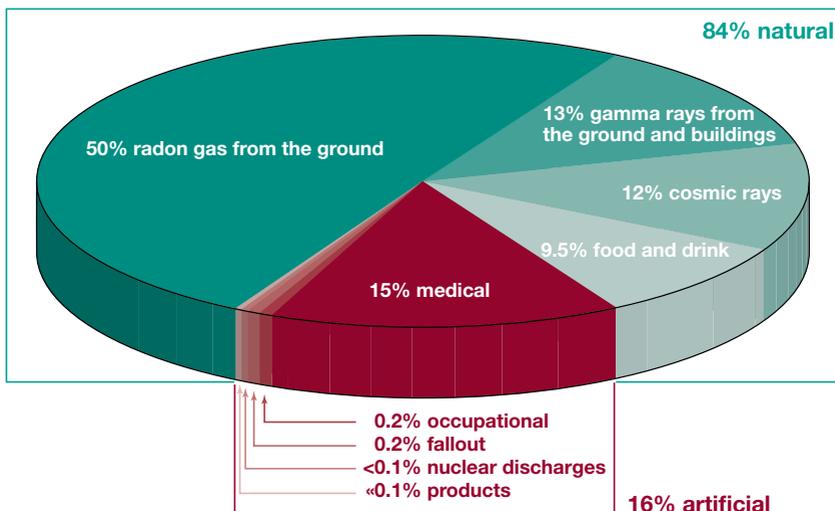
The term 'radiation dose' is used to describe the amount of energy absorbed by a material from ionising radiation passing through it. The most common measure of radiation dose to people is called effective dose, measured in units called sieverts. Effective dose takes account of the different sensitivities of organs in the body and the effects of different types of radiation. A sievert is a large dose of radiation and in most cases radiation dose will be given in microsieverts (μSv , one-millionth of a sievert) or millisieverts (mSv, one-thousandth of a sievert).

At low levels radiation causes no immediate perceptible damage to people. However, any exposure to radiation is considered to be capable of increasing the lifetime risk of cancer and of passing on hereditary illnesses to children. Individuals exposed to very high doses of radiation may receive burns to the skin, damage to the gastrointestinal, cardiovascular or nervous systems, and exceedingly high doses can cause death.

Radiation Exposures

People have always been exposed to low levels of radiation from natural sources. On average, people in the UK receive an annual dose of 2.7 mSv. Natural sources make up 84% of this dose, with the remainder coming from a variety of artificial sources.

Average annual radiation exposure of a person in the UK (2.7 mSv overall)



Natural radiation sources include gamma rays from the natural radioactivity in the Earth and in building materials, the small amounts of natural radioactivity in food and drink, and cosmic rays which bombard the Earth from space. However, by far the greatest contribution comes from breathing radon gas which is given off by natural radioactive materials in the Earth. Inhalation of radon leads to alpha-particle irradiation of the lungs and has been shown to cause lung cancer.

Artificial (man-made) sources are dominated by medical exposures. All other artificial sources contribute in total less than 0.5% of the average annual exposure.

For further information visit our website at www.gov.uk/phe.