Radioactivity

Where does radioactivity come from?
Even before the recent production of man-made radioisotopes radioactivity was an integral part of the life of the universe. Without any human intervention, it is present everywhere. The atmosphere and the Earth's crust contain naturally occurring radioactive elements.

Since the production in 1934 of the first man-made radioactive nucleus, part of the global radioactivity is man-made. The types of radiation emitted by man-made radionuclides are the same as those emitted by natural radionuclides.

85% of the radiation dose received by man is natural
All substances are made up of atoms. Some atoms are naturally unstable. To attain stability they emit mass and energy (radiation); this process is called disintegration. When these atoms disintegrate or decay they are described as being radioactive.

Background radiation is mainly natural. Life on earth has managed to cope with this varying level of radioactivity. Our cells have self-repairing mechanisms which allow them to survive relatively unscathed.

Eighty-five per cent of our annual dose comes from natural sources, which include cosmic rays, radon gas and food and drink. Fourteen per cent is the result of exposure to medical measures and one per cent comes from man-made sources such as nuclear weapon test fallouts, nuclear power and radioactive discharges.

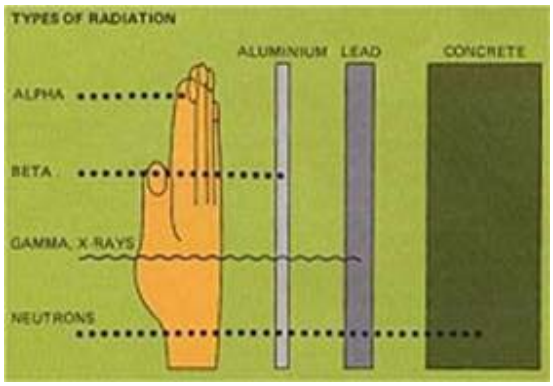
Radioactive materials and radiation are used for a wide range of purposes including:

- Cancer treatment
- Radioactive tracers for medical diagnosis
- Sterilising and preserving food and/or medical equipment
- Smoke detectors;
- Airport security;
- Radioactive dating of ancient historic objects;
- For detecting leaking pipes;
- Quality checks in construction and manufacture; and
- Checking welds.

Radiation
This is the term given to particles and energy emitted by a radioactive element. The main types of radiation with which we are concerned are: alpha or beta particles or gamma-rays, x-rays and neutrons.

- **Alpha particles** have only a very short range in air and are totally absorbed by a sheet of paper. Alpha particles do not present an external radiation hazard but they can cause harm to health if they are allowed to enter the body.
- **Beta radiation** can, in some cases, travel a few metres in air but is readily shielded by using light materials like aluminium or Perspex. Most beta radiation will not penetrate far into the body but can result in a dose to the skin.

- **Gamma rays** and x-rays can travel for many metres in air and can easily penetrate many materials. Lead or concrete shielding is normally required to significantly absorb such radiation.



Dose
Radioactivity and radiation are a measurable phenomena. There are three international units of measurement. Each one refers to very different types of data.

- **Radioactivity** is measured in becquerels (Bq). It measures the number of disintegrations of radioactive nuclei occurring each second in a sample.
- The **amount of radiation absorbed** by an organism or object exposed to radiation is measured in **grays (Gy)**.
- The **biological effects of radiation on the organism exposed** is measured in **sieverts (Sv).** This is a health physics unit. It is expressed in equivalent dose and takes into account the characteristics of the radiation and of the organ irradiated. The sievert is a large unit. It is more common to refer to dose in units of micro (uSv) or millisieverts (mSv).

A microsievert is one millionth of a sievert (1 μSv = 0.000001 Sv)
A millisievert is one thousandth of a sievert (1mSv = 0.001 Sv)

Some examples of the radiation dose a person can expect to receive in every day life include:

- The average dose received during a flight from Britain to Spain is about 0.01 mSv;
- The average dose from a chest x-ray is 0.02 mSv;
- Our bodies have a natural radioactivity of around 4,000 Bq.
- The actual radiation dose a person receives depends on factors such as age, diet, medical history, occupation and where you live. The average radiation dose due to natural background activity is 2.2 mSv per year in the UK and ranges up to 7mSv per year in some locations.

1 Bq = 1 decay per second
1 gray is 1 joule of energy absorbed by 1kg of your body..
A dose of **1 gray of beta** particles, gamma rays or x-rays = 1 sievert.
A dose of **1 gray of alpha** particles = 20 sieverts.