A nucleus is a cluster of protons and neutrons at the centre of an atom, surrounded by a cloud of electrons. The protons and neutrons are constantly moving, vibrating, and rearranging, causing some to **emit electromagnetic radiation** called **gamma rays**. Occasionally, **some nuclei also eject particles at high speed**. This emission of electromagnetic radiation or particles is known as a **nuclear reaction or nuclear decay**.

During nuclear decay, atoms may undergo a transmutation and change from one element to another.

**Radioisotopes**Most atoms contain stable nuclei. Each element may have several isotopes (atoms with the same number of protons but a different number of neutrons) - A tiny fraction of these isotopes have **unstable nuclei** and are known as **radioisotopes**. For example, carbon has three naturally occurring isotopes:
carbon-12, carbon-13, carbon-14
They are all types of carbon atoms because they all contain 6 protons.
As the number of **neutrons increase**, the nucleus **becomes unstable.
carbon-14 is a radioisotope** because it has **8 protons**.

**Types of Nuclear Decay**

* **Alpha Decay**During alpha decay the nucleus emits an alpha particle
which is a cluster of 2 protons and 2 neutrons
* **Beta Decay**
During beta decay the nucleus ejects a beta particle.
A neutron is converted into a proton & mass is unchanged.
* **Gamma Decay**
A form of electromagnetic wave similar to X-rays.

**Half-life Carbon Dating**The rate at which nuclear decay occurs is measured by a Carbon dating relies on the fact that all living things contain
radioisotope’s half-life. The **half-life** of a radioisotope is a small amount of carbon-14, which remains constant over **the time it takes for half of the nuclei to decay**. the life of an organism. When it dies carbon-14 is no longer

For example: The radioisotope radon-222 decays absorbed and begins to decay into nitrogen-14 as shown.
into polonium-218 with a half-life of 4 days.

 Carbon-14 has a
 half-life of 5730 yrs.
 By measuring the
 amount of carbon-14
 remaining, scientists
 can determine the
 number of half-lives
 that have elapsed
 since the organism died.

**Biological Effects of Radiation**
Alpha & beta particles and gamma rays are called **ionising
radiation** because they can remove electrons from atoms
and molecules. Exposing cells to ionising radiation destroys
biological molecules and can cause cells to die or mutate.

* Cell Death causes radiation burns & radiation sickness
* Cell Mutation causes cancer & genetic deformities

**Dose** - Whether exposure to radiation is harmful depends on
the type of radiation and the amount of radiation (dose)