RADIOACTIVITY REVEALED

What is Radioactivity?

Radioactivity is the result of radionuclides (unstable atoms) spontaneously emitting nuclear radiation. When the nucleus undergoes radioactive decay and converts into one of its unique isotopes, radiation may be released depending on the isotope's stability. They can either be radioactive (unstable atom) or non-radioactive (stable atom) depending on their number of protons and neutrons. Stable atoms have balanced nuclei; unstable atoms have unbalanced proton-to-neutron ratios causing them to possess high amounts of energy and radiation. (ARPANSA, 2018) Some of the everyday items we use possess concentrations of radiation.

Types of Radioactive Decay

Alpha Decay (α)

During alpha decay, the nucleus emits a particle containing 2 protons and 2 neutrons, otherwise known as an alpha, or helium particle (refer to Diagram 1). This occurs due to the nucleus having too many protons. The alpha particle itself is quite heavy as it can be blocked very easily by air, paper, and your skin. (Study.com, 2019)

Beta Decay (β)

Beta decay occurs in two ways, known as beta-negative or beta-positive decay. In beta-negative decay an unstable nucleus emits an electron and an antineutrino to satisfy the laws of conservation of energy (see Diagram 2). Beta-positive decay requires a positron (a positive electron) and a neutrino to be emitted from the unstable nucleus (refer to Diagram 2). These 'beta particles' are much lighter and faster than alpha particles. (Office of Science, n.d.)

Gamma Decay (γ)

Gamma decay differs from beta or alpha decay as no charged particles are ejected from the nucleus. Instead, a high-energy gamma ray photon is released (refer to Diagram 3). Gamma radiation is unique as the atom's composition isn't altered; rather it only changes the energy of the atom's mass. If a nucleus increases to an excited energy state, a new 'daughter' nucleus needs to release energy to relax the protons and neutrons to a ground state. (Study.com, 2019)

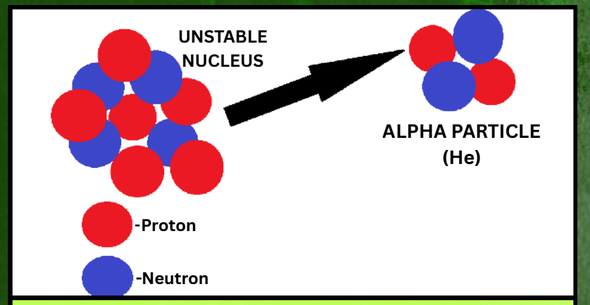


DIAGRAM 1: This diagram shows the process of alpha decay. Due to the nucleus being unstable, it omits an alpha particle to stabilise itself. The alpha particle is an isotope of helium; both have two protons.

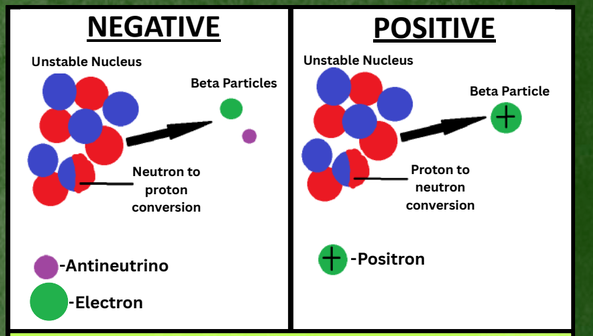


DIAGRAM 2: This diagram shows the two types of beta decay (positive and negative). A proton-to neutron change occurs in beta-positive decay and vice verca for beta-negative decay

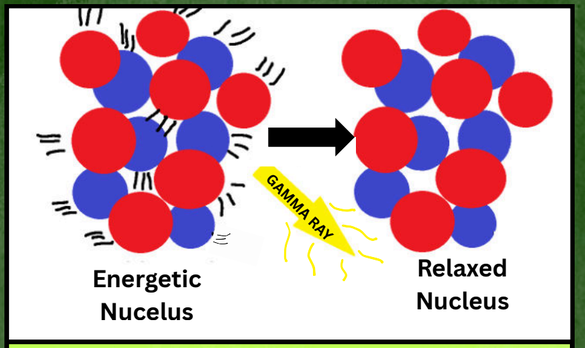


DIAGRAM 3: This diagram illustrates a gamma ray being emitted from an energetic nucleus, causing it to stabilise.

Everyday Radioactive Items

Bananas

Banana cells have traces of potassium-40, a natural, radioactive isotope, with 19 protons and 21 neutrons. (Office of Nuclear Energy, 2023) Consequently, they undergo beta decay, where the potassium-40 releases a beta particle (refer to Diagram 2). But don't worry; it would take around 50 million bananas eaten simultaneously to receive a lethal dose of radiation! (Labh, 2023)

Smoke Detectors

Ionised smoke detectors contain small amounts of Americium-241, a radionuclide that detects smoke particles. The isotope undergoes alpha decay; the alpha particles help detect smoke. The small Americium source encased in a layer of foil and ceramic restricts the heavy particles from escaping. (US EPA, 2019)

References and Acknowlegments

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