Radioisotopes and their use in Wildife Research

There are about 105 chemical elements occuring, either naturaly or artificially, as approximately 1200 isotopes.

Isolopes: Isotopes are collections of nuclei with the same number of protons hence belonging to the same chemical element but with different atomic weights, indicating a different number of total particles in the nucleus. Examples are "C12, C13, and C14 which are all isotopes of the element carbon with the same atemic number, 6, but differing atomic waight indicating 6, 7, and 8 neutrons, respectively. The first 2 are stable, but "C14 is an unstable, or radioactive, isotope with a half-life of 5730 years.

Radioactive isotopes are called nuclides.

Half life is a term denoting the time required for one half the nuclei in a collection of radioactive atoms of a particular isotope to decay to another element that might be radioactive or to a stable state.

Atomic Number (equal to the number of protons in the nucleus or electrons in the nautral state of an atom of an element)

Atomic mass may be considered to be the total mass of protons, neutrons' and electrons in a single atom (when the atom is motionless).

Radiation:

Radiation is energy that comes from a source and travels through space

and may be able to penetrate various materials. Light, radio, and microwaves are types of radiation that are called non-lonizing radiation. lonizing radiation is a kind of radiation that can produce charged particles (ions) in matter. lonizing radiation is produced by unstable atoms. Unstable atoms differ from stable atoms because unstable atoms have an excess of energy or mass or bath. Unstable atoms are said to be radioactive. In order to reach stability, these atoms give off, or emit, the excess energy or mass. These emissions are called radiation.

Types of Radiation:

Alpha radiation, Beta radiation, Gamma radiation

Alpha Radiation:

Alpha particles (denoted by the first lettor in the Greek alphabet, a) consist of 2 protons and 2 neutrons bound together into a particle identical to a hellium nucleus; hence, it can be written as He2+. It is about 8000 times heavier than an electron and has a double electric charge. Alpha particles are easily ionized, and are thus rapidly stopped when penetrating into material.

Characteristics:

1. Most alpha radiation is notable to penetrate human skin.

2. Alpha-emitting materials can be harmful to humans if the materlais are inhaled, swallowed, or absorbed through open wounds.

3. A variety of instruments has been designed to measure alpha radiation. Special training in the use of these instruments in for making accurate measurements.

4. A thin-window Geiger-Mueller (GM) probe can detec the presence of alpha radiation.

5. Instruments cannot detect alpha radiation through even a thin layer of water, dust, paper, or other material, becaus. radiation is not penetrating.

6. Alpha radiation travels only a short distance (a few inches) in air an external hazard.

7. Alpha radiation is not able to penetrate clothing. Examples of some alpha emitters: radium, radon, uranium, thorium.

Beta Raiation:

Beta particles are designatedthe Greek letter beta.

They are high-energy, high-speed electrons or positrons emitted by certain types of radioactive. The Beta particles emitted are a form of ionizing radiation also known as beta rays. The production of beta particies is termed beta decay.

Beta decay: There are two forms of beta decay, B and B", which respectively give rise to the electron and the positron

Beta Particle Radiation

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An unstable atomic nucleus with an

excess of neutrons may undergo B decay, where a neutron is converted to a proton, an electron and an electron-type antineutrino (the antiparticle of the neutrino): n-p+e + ve.

Unstable atomic nuclei with an excess of protons may undergo B' decay also called inverse beta decay, where a proton is converted into a

neutron, a positron and an electron-type neutrino:

P-n+e* + ve n Neutise an elementary particle with zero charge and a very small mass.

Characteristics

1.Beta radiation may travel saveral feet in air and is moderately penetrating

2. Beta radiation can penetrate human skin to the "germinal layer," where new sikin cells are produced. If high levels of beta-emitting contaminants are allowed to remain on the skin for a prolonged period of time, they may cause skin injury.

3. Beta-emitting contaminants may be harmful if deposited internally.

4. Most beta ernitters can be detected with a survey instrument and a thin-window G-M probe (e.g., "pancake" type).

5. Clothing provides some protection against beta radiation.

Examples of some pure beta enmitters: stronlium-90, carbon-14, tiun, and sulfur-35.

Gamma Radiation

Gamma rays (denoted by a letter of the Greek alphabet y) are form of electromagnetic radiation or light emission of frequencies produced by sub-atomic particle interactions such as electron-positron annihilation (disintegration) or radioactive decay. After a decay reaction, the nucleus is often in an "excited" state This means that the decay has resulted in producing a nucleus which still has excess energy to get rid of. Rather than emitting another beta or alpha particle, this energy is lost by emitting a pulse of electromagnetic radiation called a gamma ray. The gamma ray is identical in nature to light or micrawaves, but of very high energy.

Gamma-Ray Radiation

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Like all forms of electromagnetic radiation, the gamma ray has no mass and no charge. Gamma rays interact with material by colliding electrons in the shells of atoms. They lose their energy slowly in material, being able to travel significant distances before stopping Depending on their initial energy, gamma rays can travel from 1 to 100 of meters in air and can easily go right through people. It is important to note that most alpha and beta emitters also emit gamma rays as part of their decay process. However, there is no such thing as a "pure" gamma emitter.

Characteristics

1. Gamma radiation or x rays are able to travel many feet in air and many inches in human tissue. They readily penetrate most materials and are sometimes called "penetrating" radiation.

2. X rays are like gamma rays. X rays, too, are penetrating radiation.

3. Gamma radiation and x rays are electromagnetic radiation like radio-waves, and ullraviolat light) These electromnnetic

4. Gamma rediation is easily detected by survey meters with a sodium resp lodide detector probe.

5. Gamma radiation and/or characteristic x rays frequently accompany the emission of alpha and beta radiation during radioactive decay Examples of some gamma.emilters: iodine-131, cesium-137, coball-B0 radium-226, and technetium-99m.

Detection of Radiation

also Radiation cannot be detected by human senses. A variety of handheld and laboratory instruments is available for detecting and measuring neutral radiation. The most common handheld or portable instrumenteng

1. Geiger Counter, with Geiger-Mueller (G-M) Tube or Pro

2. MicroR Meter, with Sodium lodide Detector

3. Portable Multichannel Analyzer

4. lonization (lon) Chamber

5. Neutron REM Meter, with Proportional Counter

6. Radon Detectors

The most common laboratory instruments are:

1. Liquid Scintillation Counters

2. Proportional Counter

3. Multichannel Analyzer System Radiations

USAGE

Usinng a radioactive label in a compound or in an animal is the same as attaching a band or tag to an individual to distinguish it from the group. It is assumed that the behavior of the labeled or tagged individual is the same as the rest of the group.

1. Tracera, such an "P32, Ca45, S35, "Fe59, "Cu64, and others, can be used as Single elements in nutrition and matabolism studies.

2. Clinical diagnosis for certain diseases and glandular funclions nn- possible through the use isotopes such as I131.

3. A number of isotopes have been used to label or mark individual animals Grouse, ducks, fish, toads, reptiles and a number Or mammals have been labeled with radioactive gold, phosphorous Cobalt, silver, tantalum and others.

4. Nest materials as well as animals, have been marked, movements studies by radioactive determined, predator-prey and food-ahain relations studied, all by radioisotope tracers.

5. One of the mast importart uses af isotope-labeled compounds has been to study the distribution, translocation, and bioaccumulation of pesticides in natural environments as well as within closed laboratory systems.