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1. What are radioactive tracers?

A radioactive tracer, radiotracer, or radioactive label, is a chemical compound in which one or more atoms have been replaced by a radionuclide so by virtue of its radioactive decay it can be used to explore the mechanism of chemical reactions by tracing the path that the radioisotope follows from reactants to products. Radiolabeling or radiotracing is thus the radioactive form of isotopic labeling. A radioactive tracer can also be used to track the distribution of a substance within a natural system such as a cell or tissue, or as a flow tracer to track fluid flow.
1. Radioactive tracers are also used to determine the location of fractures created by hydraulic fracturing in natural gas production.
3. Radioactive tracers form the basis of a variety of imaging systems, such as, PET scans, SPECT scans and technetium scans. Radiocarbon dating uses the naturally occurring carbon-14 isotope as an isotopic labels.

2. Application of tracers in medicine?

Nuclear medicine uses radioactive isotopes in a variety of ways. One of the more common uses is as a tracer in which a radioisotope, such as technetium-99m, is taken orally or is injected or is inhaled into the body. The radioisotope then circulates through the body or is taken up only by certain tissues. Its distribution can be tracked according to the radiation it gives off. The emitted radiation can be captured by various imaging techniques, such as single photon emission computed tomography (SPECT) or positron emission tomography (PET), depending on the radioisotope used. Through such imaging, physicians are able to examine blood flow to specific organs and assess organ function or bone growth. Radioisotopes typically have short half-lives and typically decay before their emitted radioactivity can cause damage to the patient's body.
Therapeutic applications of radioisotopes typically are intended to destroy the targeted cells. This approach forms the basis of radiotherapy , which is commonly used to treat cancer and other conditions involving abnormal tissue growth, such as hyperthyroidism. In radiation therapy for cancer, the patient's tumor is bombarded with ionizing radiation, typically in the form of beams of subatomic particles, such as protons, neutrons, or alpha or beta particles, which directly disrupt the atomic or molecular structure of the targeted tissue. Ionizing radiation introduces breaks in the double-stranded DNA molecule, causing the cancer cells to die and thereby preventing their replication. While radiotherapy is associated with unpleasant side effects, it generally is effective in slowing cancer progression or, in some cases, even prompting the regression of malignant disease.