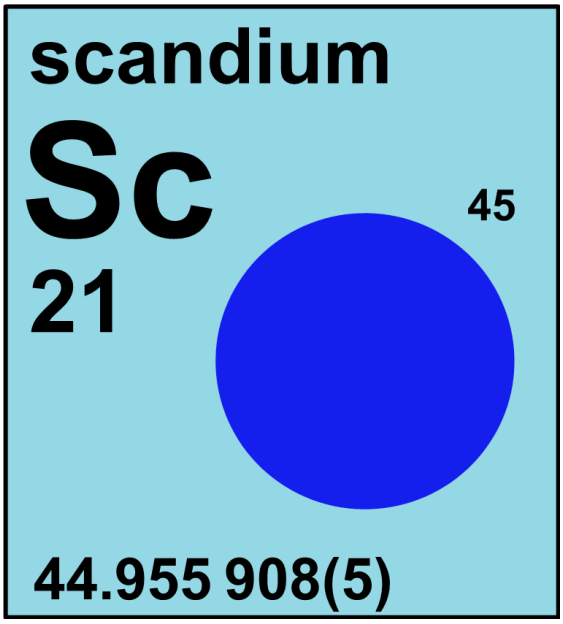
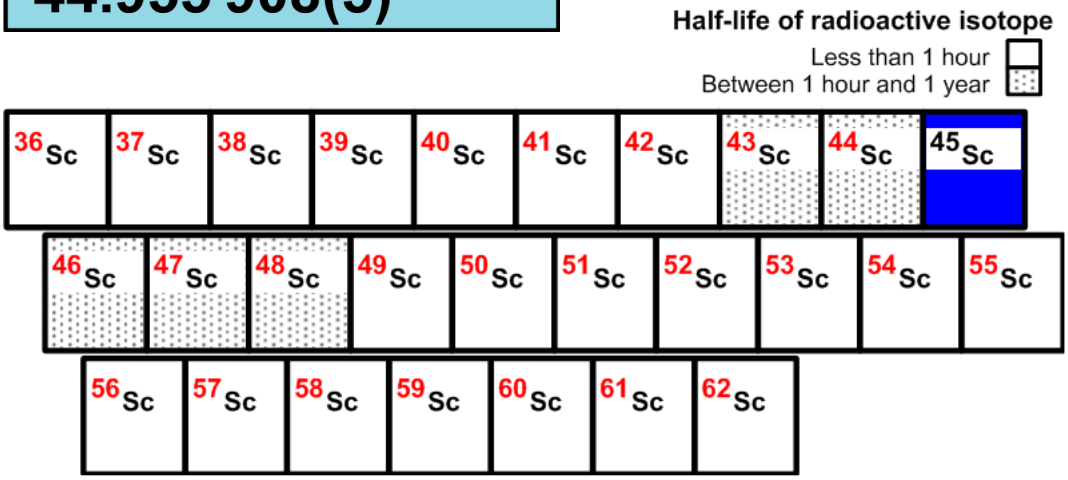
4.21 scandium



Stable isotope	Relative atomic mass	Mole fraction
^{45}Sc	44.955 908	1



4.21.1 Scandium isotopes in biology

Radioactive ^{46}Sc is used as a non-absorbed **isotopic reference material** for determining digestibility, absorption in the gut, and secretion sites for nutrients associated with feed residues in ruminating animals (animals that chew their food repeatedly for an extended period of time) [187].

4.21.2 Scandium isotopes in Earth/planetary science

The **radioactive isotope** ^{46}Sc has been used for sediment labeling to determine the transportation of sediments by water flow in rivers, estuaries, harbors, and seas. The **half-life** of ^{46}Sc is about 84 days and when released into an estuary with similar grain density and grain size, a gamma spectrometer (instrument for measuring the intensity of **gamma radiation** versus the energy of

each **photon**) can be used to measure the intensities of ^{46}Sc in the sediments and the movement of the sediments can be determined [188-190].

4.21.3 Scandium isotopes in industry

^{46}Sc is a beta emitter and has been used as a **tracer** in oil refinery crackers for crude oil (converting crude oil into gasoline and other lower-molecular weight hydrocarbon fractions). Its beta radiation enables the substance to be tracked as the oil travels [191]. Due to its easily traceable properties, coastal engineers use ^{46}Sc to develop dredging strategies and to design navigation channels based on silt movement [189].

4.21.4 Scandium isotopes in medicine

^{46}Sc is used in isotope-carrying antibodies for bonding with tumor-associated cell surface antigens (substances that causes the production of an antibody when introduced into the body, e.g., toxins, bacteria, and viruses). ^{46}Sc is added to **DTPA**-derivatized (process by which a compound is chemically changed, producing a new compound that has properties more amenable to a particular analytical method) **monoclonal antibodies** and has been shown to target tumor cells, specifically ***in vivo***, where it accumulates to high levels in the tumor (Figure 4.21.1) [192, 193].

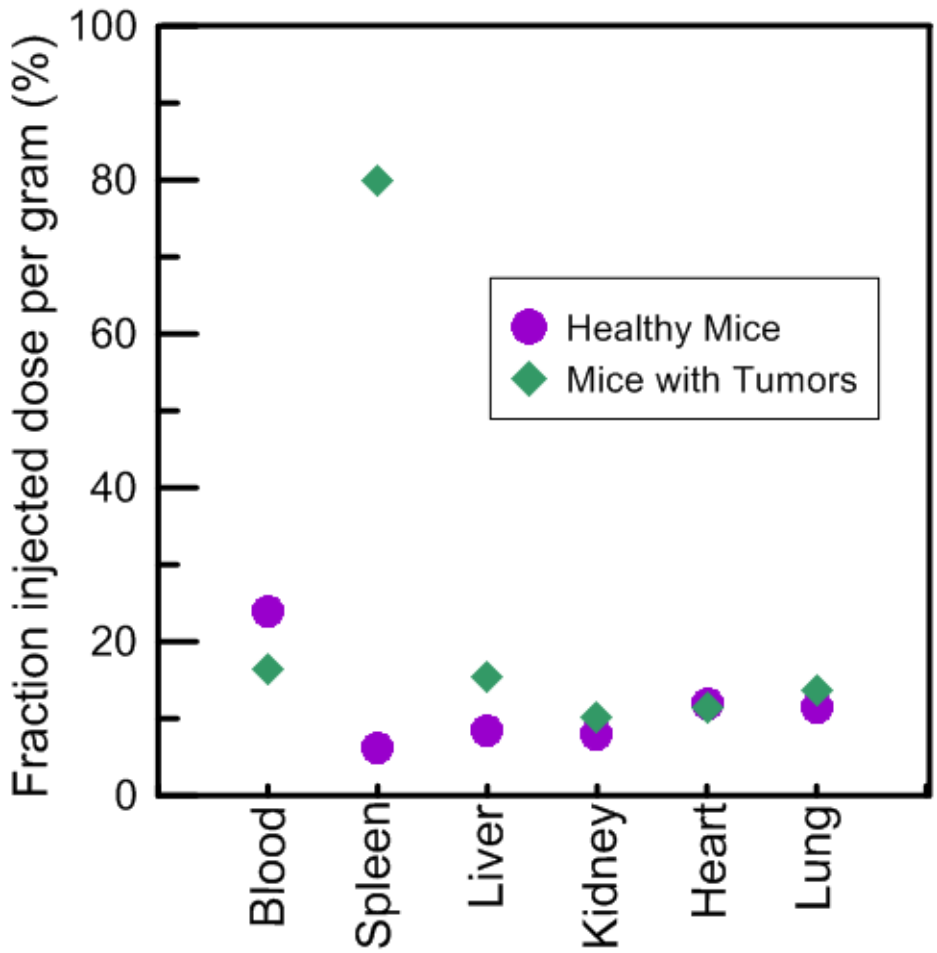


Fig. 4.21.1: Comparison of biodistribution of ^{46}Sc citrate and ^{46}Sc-labeled ca**DTPA**-antibody conjugates in healthy mice (circles) and leukemic mice (diamonds) one hour after injection in tail vein (modified from [192, 193]).