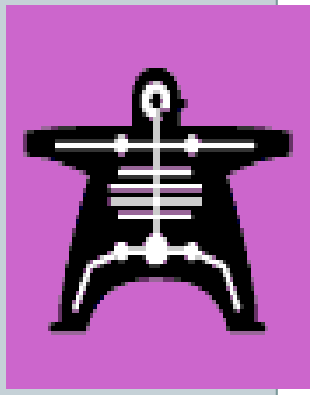
Radioactivity and Nuclear Energy

Medical Applications of Radioactivity

Although we owe the rapid advances of the medical sciences in recent decades to many causes, one of the most important has been the discovery and use of radiotracers—

Radiotracers are radioactive nuclides that can be introduced into Organisms and *traced (Followed) for diagnostic Purposes*.



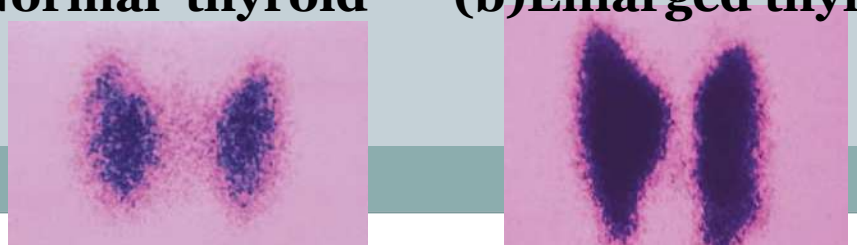
For example, the incorporation of nuclides such as carbon-14 into nutrients has yielded important information about how these nutrients are used in organisms to provide energy for the body

Nuclides used as radiotracers have short half-lives so that they disappear rapidly from the body.

Medical Applications of Radioactivity

- Example of Radiotracers used in medical applications include:
- Iodine-131 has proved very useful in the diagnosis and treatment of illnesses of the thyroid gland. Patients drink a solution containing a small amount of NaI that includes Iodine-131, and the uptake of the iodine by the thyroid gland is monitored with a scanner

(a)Normal thyroid **(b)Enlarged thyroid**



After consumption of Nal with Iodicne-131, the patient's thyroid is scanned for radioactivity levels to determine the efficiency of iodine absorption. (a) Scan of radioactive iodine in a normal thyroid (b) Scan of an enlarged thyroid

Medical Applications of Radioactivity

Example of Radiotracers used in medical applications include:

- Thallium-201 can be used to assess the damage to the heart muscle in a person who has suffered a heart attack, because thallium becomes concentrated in healthy muscle tissue.

- Technetium-99, which is also taken up by normal heart tissue, is used for damage assessment in a similar way.

Medical Applications of Radioactivity

- Radiotracers provide sensitive and nonsurgical methods for learning about biological systems, for detecting disease, and for monitoring the

action and effectiveness of drugs. Some useful radiotracers are listed in the table to the right

Table 19.4

Some Radioactive Nuclides, Their Half-lives, and Their Medical Applications as Radiotracers*

Nuclide	Half-Life	Area of the Body Studied
^{131}I	8.1 days	thyroid
^{59}Fe	45.1 days	red blood cells
^{99}Mo	67 hours	metabolism
^{32}P	14.3 days	eyes, liver, tumors
^{51}Cr	27.8 days	red blood cells
^{87}Sr	2.8 hours	bones
^{99}Tc	6.0 hours	heart, bones, liver, lungs
^{133}Xe	5.3 days	lungs
^{24}Na	14.8 hours	circulatory system

*Z is sometimes not written when listing nuclides.

Medical Applications of Radioactivity

There are a number of other medical applications, also including:

- X-Rays How: Bones are denser than skin. X-Rays pass through skin and bones are detected on photographic film.
  Use: diagnose, monitor, treat
  Examples: hyperthyroidism, broken bones, bone cancer

- CAT Scan (Computerized Axial Tomography) + CT scan (Computed Tomography) How: X-Ray machines connected to computers in the above machines.
  Use: Provides images that show the shapes and details of internal organs to help identify tumors, size anomalies, or functional organ problems

- Radiation Therapy How: X-Rays
  Use: Kills cancerous tissue, reduces the size of tumors, reduced pain
  Examples; radioactive iodine (I-131: used to treat thyroid cancer)

- The End