Radioactive Dating
Naturally occurring radioactive isotopes such as $^{14}C$ are used to date objects that were once living, such as wood. For example, from a study of artifacts found at the site, scientists determined that Stonehenge was built nearly 4,000 years ago.

Space Exploration
Sojourner used alpha particles to identify chemical elements present in Martian rocks. On Earth, nuclear reactions are used in many areas from criminal investigations to art authentication.

Nuclear Reactors
Nuclear reactors use the fission of $^{235}U$ or $^{239}Pu$ nuclei to produce electric power. Reactors and most other nuclear applications generate radioactive waste; disposal of this waste is a subject of current research.

Smoke Detectors
Many smoke detectors use a small amount of the alpha emitter $^{241}Am$ to ionize the air. Smoke entering the detector reduces the current and sets off the alarm.

Nuclear Medicine
Radioactive isotopes, such as $^{99m}Tc$, $^{67}Ga$, and $^{131}I$, are commonly used in the diagnosis and treatment of disease. Positron emitters such as $^{18}F$ are used in Positron Emission Tomography (PET) to generate images of brain activity.

Magnetic Resonance Imaging
Magnetic Resonance Imaging (MRI) makes use of atomic transitions involving the magnetic field of a nucleus to study the local chemical environment. This technique accurately maps the density of hydrogen to produce three-dimensional images of the human body.

Astrophysical pictures courtesy NASA/JPL/Caltech and AURA/STScI.