Isotope Encyclopedia Article

Isotope

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Isotope

Forms of an element that have the same number of protons but differ in their atomic weights are called *isotopes* of that element. The atomic number of an **atom** is equal to the number of protons found within its **nucleus**. The atomic **weight** of an atom includes both the **mass** of protons and neutrons found in the nucleus. Therefore, because isotopes have the same number of protons, or the same atomic number, but different masses, they have different numbers of neutrons. Because they have the same number of protons, isotopes of the same element generally have identical chemical characteristics even though their masses differ. For example, the element **carbon**, atomic number 6, normally has an atomic weight of 12 atomic mass units. Its isotope, Carbon-14, has the same atomic number, but an atomic mass of 14. Atoms of this isotope of carbon are heavier than normal because each atom has two additional neutrons in its nucleus. Approximately 275 isotopes exist of the 81 stable elements in the **Periodic Table** of Elements. All elements have known isotopes.

Because of the particle imbalance, isotope nuclei having excess neutrons are unstable. Isotopes with unstable nuclei spontaneously convert to more stable forms over time. This process, called nuclear decay, releases **subatomic particles** and **energy** called **radiation**. Accordingly, such isotopes are called **radioisotopes**. Over 800 known radioisotopes exist. Radioisotopes are important elements used in biological and medical research. Radioisotopes that emit very tiny, but detectable, levels of radiation are used as labels, or molecular tags, to trace the paths of chemicals through tissues. Some radioisotopes, for example, are used to detect disease states or blockage in the human gastrointestinal tract. When an isotope solution is swallowed by the patient under investigation, x-ray film detects the presence of the radioisotope inside of the patient, providing valuable internal information without surgery. Similarly, radioisotopes such as technetium-99 can be used to detect bone cancer using sophisticated imaging techniques.

Other radioisotopes are highly radioactive and can actually cause harm. **Heavy water**, for example, is a dangerously radioactive byproduct of nuclear **power** plants. Heavy water consists of molecular water that contains isotopes of hydrogen and/or **oxygen**. This "heavy" water (due to excess neutrons) is water that was used to cool uranium rods in the controlled **chain reaction** of **nuclear power** plants.