

## main points

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- The nuclei of some isotopes of some elements are inherently unstable, resulting in the emission of particles and energy from these nuclei so that they decay into stable nuclei.
- Among the most significant ways that isotopes can become more stable is by releasing alpha particles, beta particles, gamma radiation, and, in a few cases, by fission.
- The energy released in nuclear transformations is much greater than that in chemical changes involving electron exchange. This intense nuclear energy has resulted in sharp debate about its problems and possibilities.
- A decay series is said to occur when a nuclide undergoes a series of emissions to reach stability.
- Each unstable nuclide has a rate of nuclear decay characterized as its half-life.
- Radioactive nuclides can be used for applications including dating of old objects, detection of tumors, meeting the energy needs of society, and as weapons of mass destruction.
- Nuclear fission is the splitting of a heavy, energetically unstable nucleus into lighter, more stable ones.
- Fission can occur at the subcritical, critical, or supercritical levels. Nuclear power generation relies on the controlled fission at the critical level. Supercritical fission is at work when nuclear warheads detonate.
- Fusion is the coming together of two nuclei to produce a larger nucleus. In this process, tremendous amounts of energy are liberated as heat and light.