

## CHAPTER 21 LEARNING OBJECTIVES

### Learning Objectives (sections 21.1-21.9)

You should be able to:

1. Write balanced equations for nuclear reactions, identifying the types of radiation and nuclides involved.
2. Determine the effect of different types of decay on the neutron/proton ratio and predict the type of decay that a nucleus will undergo based on its composition relative to the belt of stability.
3. Write balanced equations for nuclear transmutations.
4. Calculate half-life, age of an object, or the remaining amount of radioisotope, using first-order kinetics.
5. Explain how radioisotopes can be used in dating objects and as radiotracers.
6. Explain how radioactivity is detected, including a simplified description of the basic design of a Geiger counter.
7. Use Einstein's relation,  $\Delta E = c^2\Delta m$ , to calculate mass defects, energy changes, and nuclear binding energies.
8. Classify nuclear reactions as fission or fusion, and state which types of nuclei produce energy when undergoing these processes.
9. Explain the function of the major components of a nuclear reactor (fuel elements, control rods, moderator, and cooling liquid).
10. Explain the fundamental concepts involved in fission nuclear weapons (including chain reaction and critical mass).
11. Explain the penetrating and biological effects of radiation.
12. Define the units used to describe the level of radioactivity (*curie*) and to measure the effects of radiation on biological systems (*rem* and *rad*).
13. Describe the various sources of radiation to which the general population is exposed, and indicate the relative contributions of each.
14. Understand and explain the boldface terms in the Summary and Key Terms section of Chapter 21 (pages 859-860).