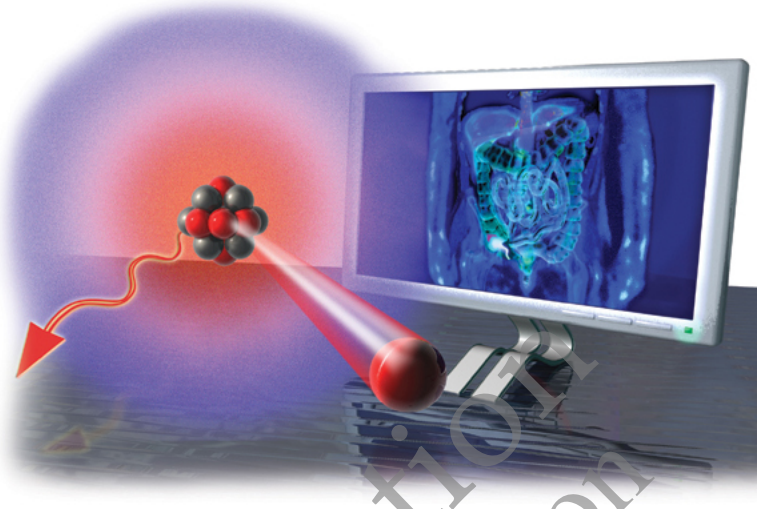
Pearson

Chapter 20
Radioactivity and Nuclear Chemistry



Antibodies labeled with radioactive atoms help to diagnose an infected appendix.

Learning Outcomes

> "I am among those who think that science has great beauty. A scientist in his laboratory is not only a technician; he is also a child placed before natural phenomena which impress him like a fairy tale."
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> *—Marie Curie (1867–1934)*

IN THIS CHAPTER, WE EXAMINE RADIOACTIVITY and nuclear chemistry, both of which involve changes within the *nuclei* of atoms. Unlike typical chemical processes, in which elements retain their identity, nuclear

reactions often result in one element changing into another, frequently emitting tremendous amounts of energy in the process. Radioactivity has numerous applications, including the diagnosis and treatment of medical conditions such as cancer, thyroid disease, abnormal kidney and bladder function, and heart disease. Naturally occurring radioactivity allows us to estimate the age of fossils, rocks, and ancient artifacts. And the study of radioactivity, perhaps most famously, led to the discovery of nuclear fission, used for electricity generation and nuclear weapons. In this chapter, we discuss radioactivity—how it was discovered, what it is, and how we use it. Radioactivity—like other chemical phenomena we have explored—also depends on structure, but in nuclear processes it is the structure of the nucleus that determines the radioactive properties. A complete explanation of how nuclear structure affects radioactive properties is beyond our scope, but in this chapter we at least begin to explore some of the important factors.