

CHAPTER 25

NUCLEAR RADIATION

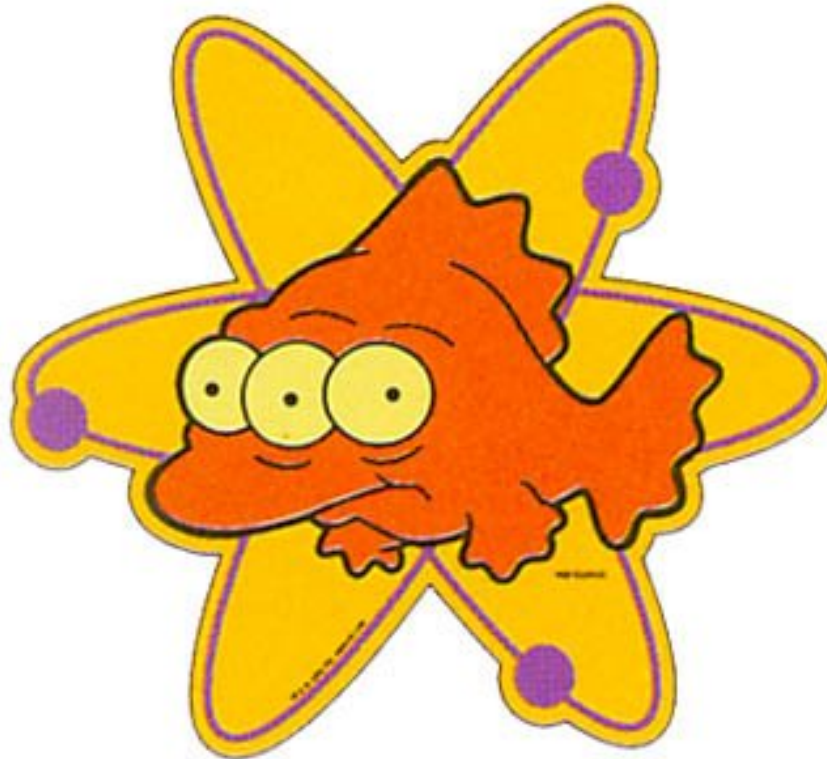
Marie Curie was a Polish scientist whose research led to many discoveries about radiation and radioactive elements. In 1934 she died from leukemia caused by her long-term exposure to radiation. You will learn about the various types of radiation and their effects.



RADIOACTIVITY

Radioactivity

- How does an unstable nucleus release energy?



Marie Curie (1867-1934) and Pierre Curie (1859-1906)

- showed that rays emitted by uranium atoms caused fogging in photographic plates.
- **Radioactivity**
 - process by which materials give off such rays.
- **Radiation**
 - The penetrating rays and particles emitted by a radioactive source.



- Nuclear reactions differ from chemical reactions in a number of important ways.
 - In chemical reactions
 - atoms tend to attain stable electron configurations by losing or sharing electrons.
 - In nuclear reactions
 - the nuclei of unstable isotopes, called **radioisotopes**, gain stability by undergoing changes.

- An unstable nucleus releases energy by emitting radiation during the process of radioactive decay.

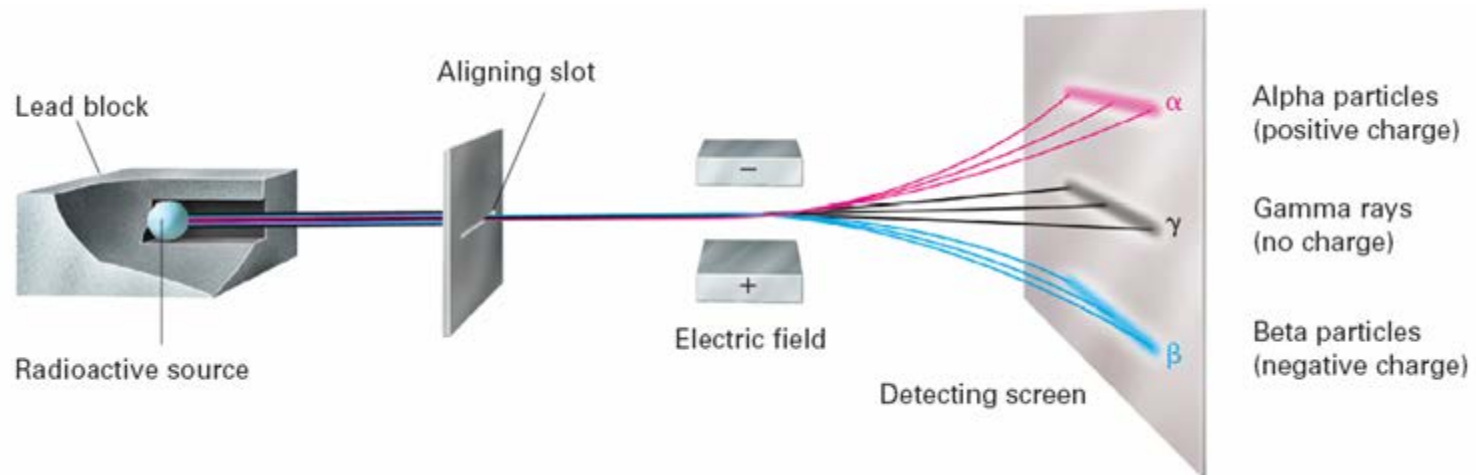


Types of Radiation

- What are the three main types of nuclear radiation?

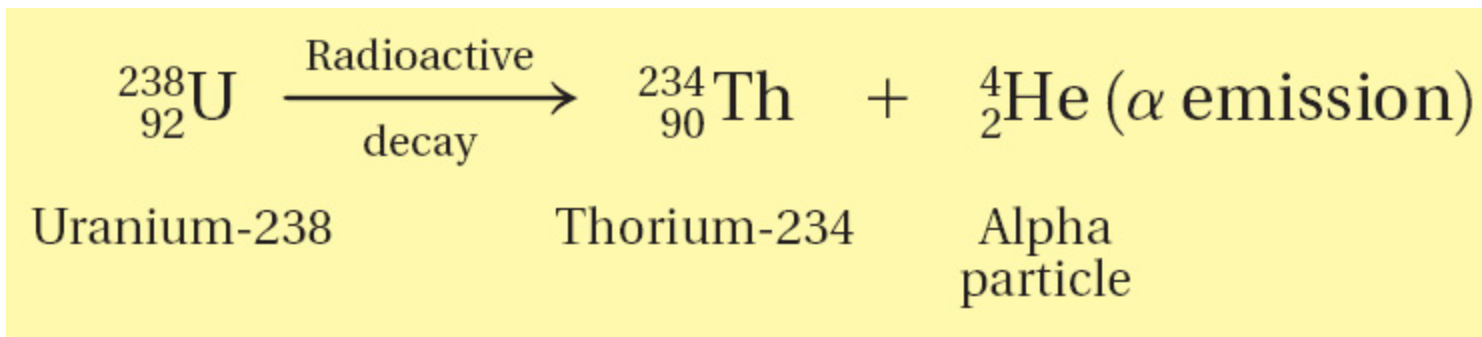


- Three main types of nuclear radiation:
 - alpha radiation
 - beta radiation
 - gamma radiation

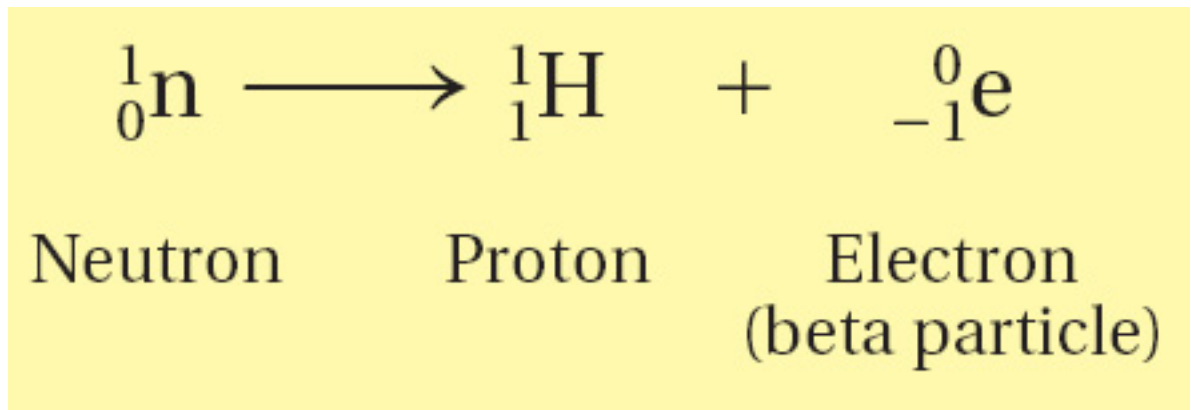


- Alpha Radiation

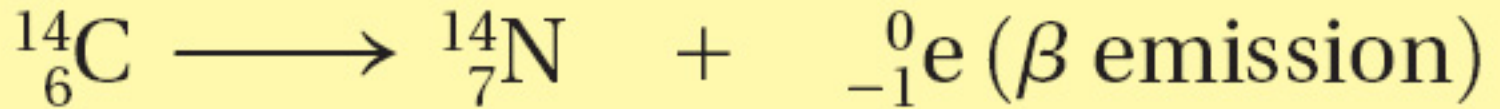
- consists of helium nuclei
- have been emitted from a radioactive source
- called **alpha particles**
- contain two protons and two neutrons
- have a double positive charge



- Beta Radiation
 - An electron
 - from the breaking apart of a neutron
 - **beta particle.**



- Example:
 - Carbon-14
 - emits a beta particle
 - radioactive decay
 - to form nitrogen-14.



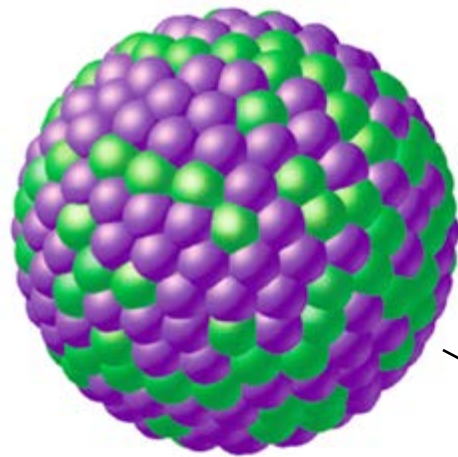
Carbon-14
(radioactive)

Nitrogen-14
(stable)

Beta
particle

Alpha decay

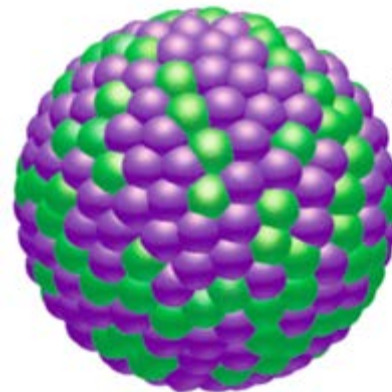
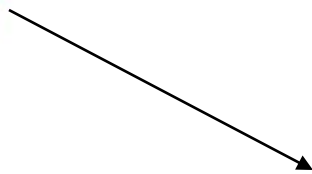
Alpha particle



$^{238}_{92}\text{U}$



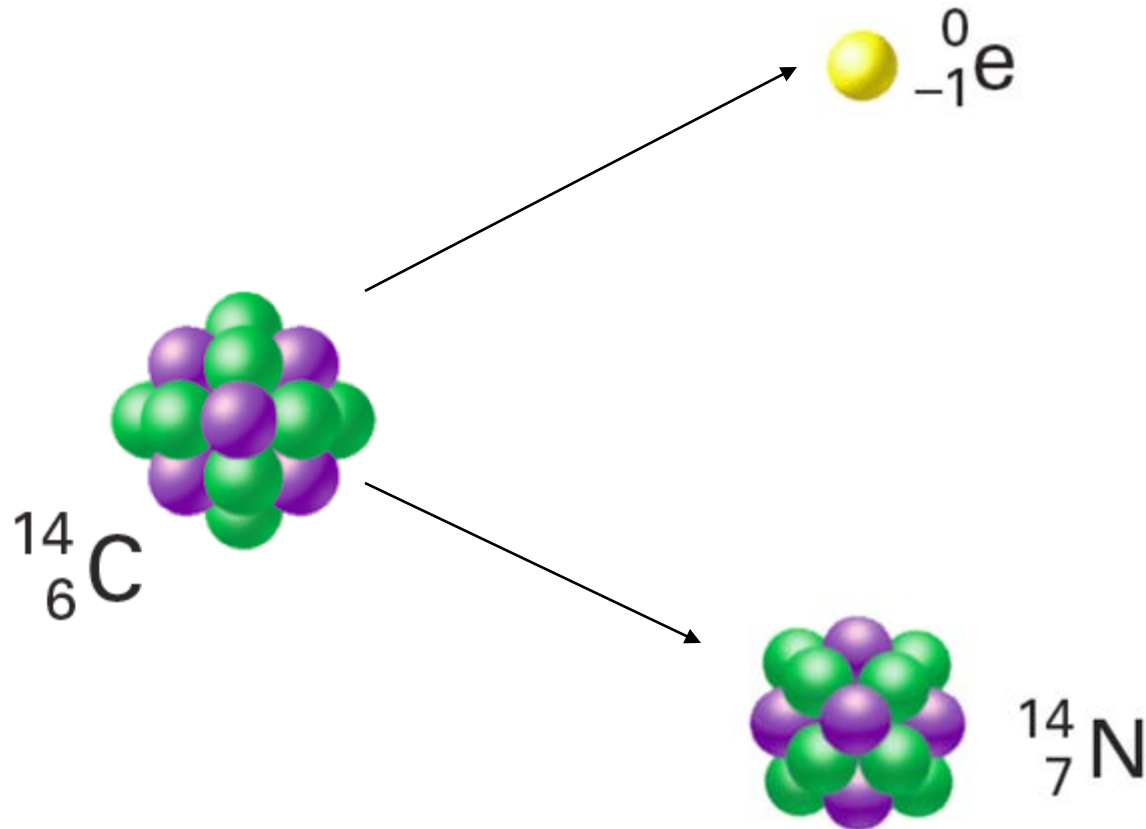
^4_2He



$^{234}_{90}\text{Th}$

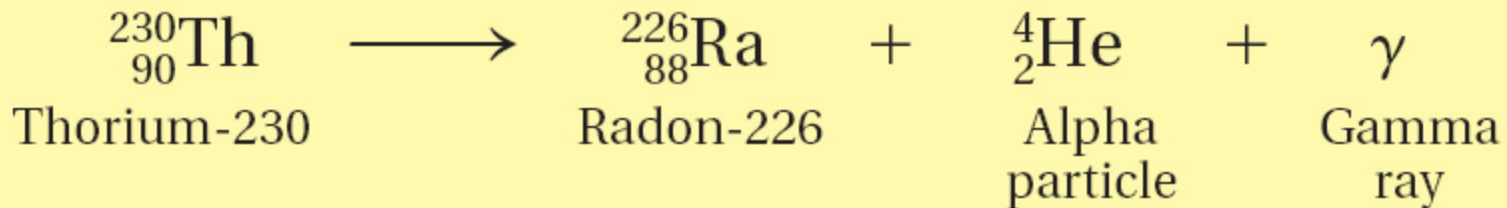
Beta decay

Beta particle



Gamma Radiation

- high-energy photon
- emitted by a radioisotope
- called a **gamma ray**
- are electromagnetic radiation.



- Alpha particles are the least penetrating.
- Gamma rays are the most penetrating.

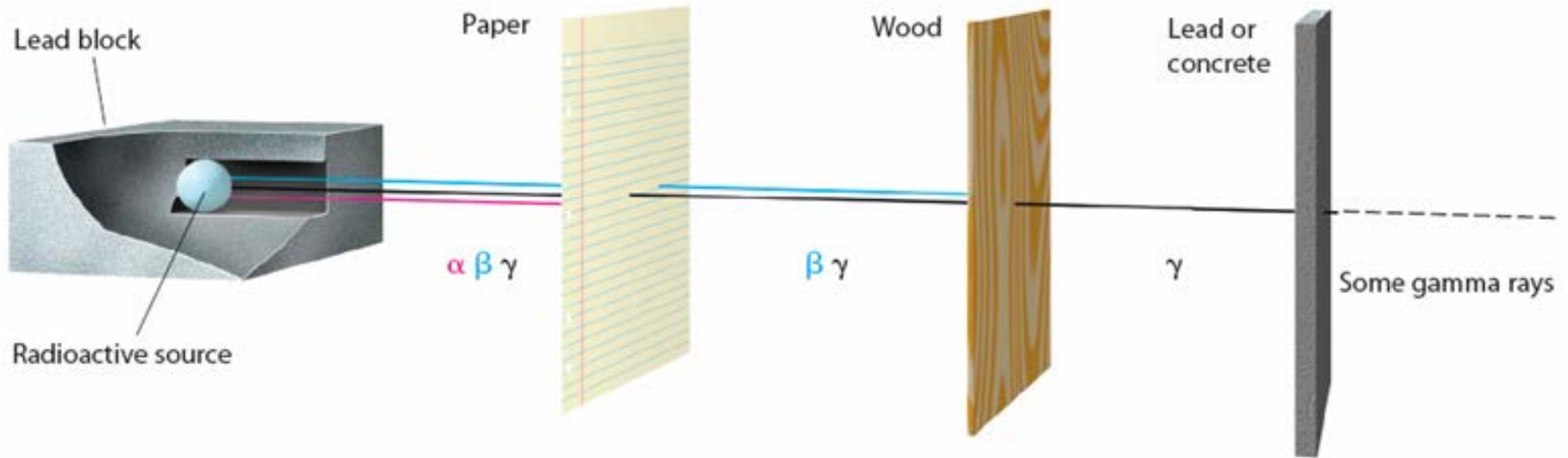


Table 25.1**Characteristics of Some Types of Radiation**

Property	Alpha radiation	Beta radiation	Gamma radiation
Composition	Alpha particle (helium nucleus)	Beta particle (electron)	High-energy electromagnetic radiation
Symbol	$\alpha, {}^4_2\text{He}$	$\beta, {}^0_{-1}\text{e}$	γ
Charge	2+	1-	0
Mass (amu)	4	1/1837	0
Common source	Radium-226	Carbon-14	Cobalt-60
Penetrating power	Low (0.05 mm body tissue)	Moderate (4 mm body tissue)	Very high (penetrates body easily)
Shielding	Paper, clothing	Metal foil	Lead, concrete (incompletely shields)

QUIZ.



1. Certain elements are radioactive because their atoms have

A. more neutrons than electrons.

B. an unstable nucleus.

C. a large nucleus.

D. more neutrons than protons.

2. An unstable nucleus releases energy by

- A. emitting radiation.
- B. thermal vibrations.
- C. a chemical reaction.
- D. giving off heat.

3. Which property does **NOT** describe an alpha particle?

- A. 2+ charge
- B. a relatively large mass
- C. a negative charge
- D. low penetrating power

4. When a radioactive nucleus releases a high-speed electron, the process can be described as

- A. oxidation.
- B. alpha emission.
- C. beta emission.
- D. gamma radiation.

END

