

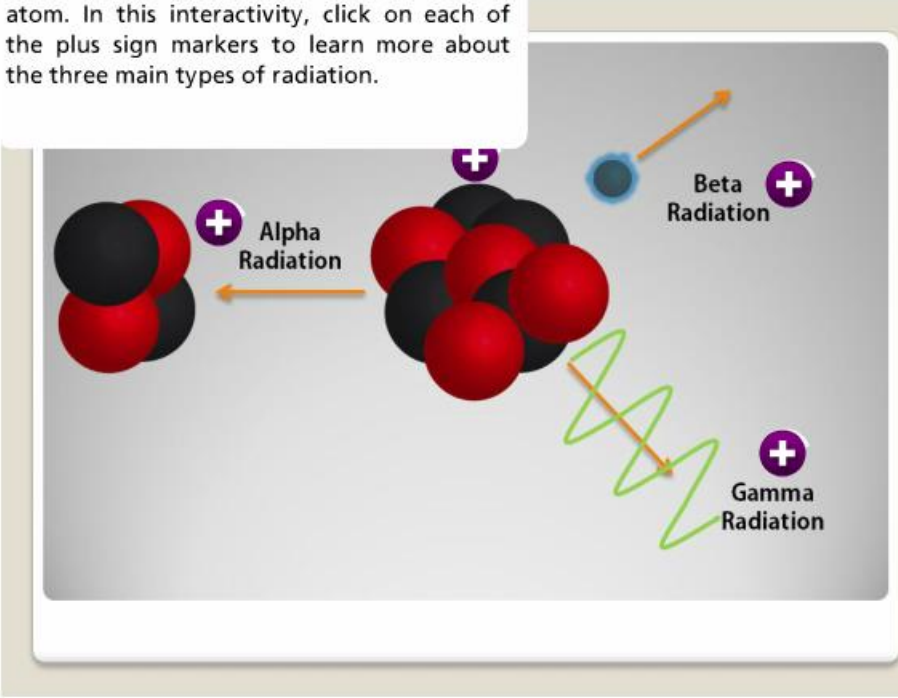
Module 2: Atomic Structure and the History of Atomic Theory

Topic 5 Content: Three Types of Radiation Presentation Notes

Introduction

Introduction

Radiation is produced through processes that take place within an unstable nucleus of an atom. In this interactivity, click on each of the plus sign markers to learn more about the three main types of radiation.



The diagram illustrates the three main types of radiation originating from an unstable nucleus. The central nucleus is composed of red and black spheres. Three types of radiation are shown:

- Alpha Radiation:** Represented by a cluster of four spheres (two red, two black) moving away from the nucleus.
- Beta Radiation:** Represented by a small blue sphere moving away from the nucleus.
- Gamma Radiation:** Represented by a green wavy line moving away from the nucleus.

Each radiation type is labeled with a plus sign marker (+).

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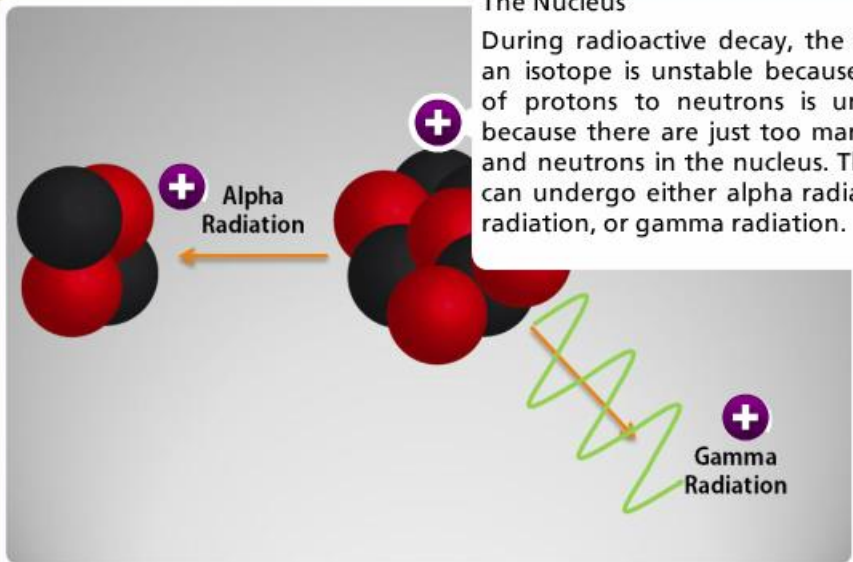
Module 2: Atomic Structure and the History of Atomic Theory

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The Nucleus

Three Types of Radiation

The Nucleus
During radioactive decay, the nucleus of an isotope is unstable because the ratio of protons to neutrons is unequal, or because there are just too many protons and neutrons in the nucleus. The nucleus can undergo either alpha radiation, beta radiation, or gamma radiation.



The diagram shows a central nucleus on the right, composed of red and black spheres. An arrow labeled 'Alpha Radiation' points left towards a separate cluster of four spheres (two red, two black). Another arrow labeled 'Gamma Radiation' points right from the nucleus towards a green wavy line representing a photon. Both radiation types are accompanied by a purple circle with a white plus sign.

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Alpha Radiation

The slide is titled "Alpha Radiation" and is part of a presentation on "Three Types of Radiation". It features a central diagram and a text box. The diagram shows a large nucleus (parent) on the left, which is a cluster of red and black spheres. An arrow points from this nucleus to a smaller nucleus (daughter) on the right, also a cluster of red and black spheres. A separate alpha particle, represented by a purple circle with a white plus sign, is shown moving away from the parent nucleus. The text box contains a nuclear equation and three key points about alpha decay.

Alpha Radiation

$$\begin{array}{c} 238 \\ 92 \\ \text{U} \end{array} \rightarrow \begin{array}{c} 4 \\ 2 \\ \text{He} \\ \alpha \end{array} + \begin{array}{c} 234 \\ 90 \\ \text{Th} \\ \text{Daughter} \end{array}$$

Notice three things:

1. When a particle undergoes alpha decay, it loses four mass particles and two protons.
2. The atomic numbers and mass numbers are equal to each other on both sides of the equation.
3. A new particles is created. In this case it is thorium.

Alpha radiation occurs when an alpha particle is ejected with high energy from an unstable nucleus. The alpha particle is represented by the symbol α , and contains two protons and two neutrons with a net positive charge. Since the particle has two protons, it is simply a helium nucleus. Although alpha particles are emitted with high energy, they lose energy quickly as they pass through both matter and air. This limits any distance travel for the particles. Alpha particles can be stopped by a thin piece of paper, or the human skin. Since

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Beta Radiation

Beta Radiation

$$\begin{matrix} 137 & & & & 137 \\ 55 & \text{Cs} & \longrightarrow & & 56 & \text{Ba} \\ & & & & & \text{Electron} \\ & & & & & \beta \end{matrix}$$

Notice:

1. Just like in alpha decay, the masses atomic number of each side of the arrow are equal.
2. During beta radiation one neutron was changed into a proton. The result is an element one atomic number greater.

Parent β **Daughter**

Beta particles are identical to electrons and have a charge of negative one. The beta particle is represented by the symbol β , and it leaves the mass number of the nuclei unchanged. A beta particle is minute in comparison to that of an alpha particle, and it has a much greater penetrating ability. An alpha particle can be stopped by a piece of paper, but beta particles pass right through. Beta particles can be stopped by aluminum foil, or even wood. The electron that is released through beta radiation was not present

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Module 2: Atomic Structure and the History of Atomic Theory

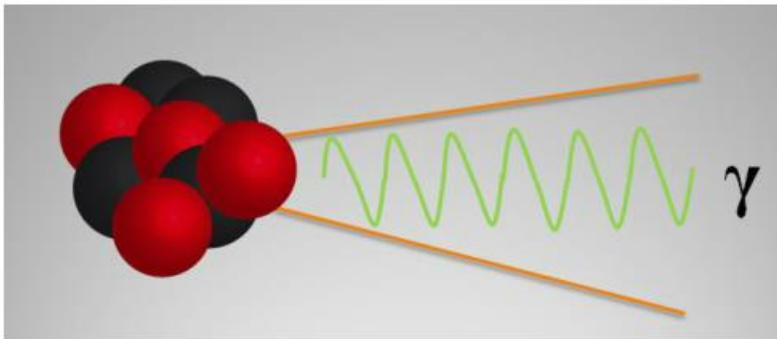
Topic 5 Content: Three Types of Radiation Presentation Notes

Gamma Radiation

Three Types of Radiation

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Gamma Radiation



The diagram shows a cluster of red and black spheres representing an atomic nucleus on the left. Two orange lines diverge from the nucleus, forming a cone that contains a green wavy line representing a gamma ray. The Greek letter gamma (γ) is placed to the right of the wavy line.

Gamma radiation is a high energy photon rather than a particle. Represented by the symbol γ , these rays are similar to x-rays, but have a shorter wavelength and more energy. The penetrating ability of gamma rays is higher than both alpha and beta particles. Gamma rays can only be stopped by several centimeters of lead or more than a meter of concrete. Gamma rays can easily pass right through the human body.

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