Radiation

- occurs when unstable nuclei of atoms decay and release energy or particles.

- can cause burns, cancers, and death.

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☆ ***Radiation-*** energy or particles that can travel through space & matter.

☆is measured in rem or mrem

☆Doses above ***100 rem*** cause the first signs of radiation sickness

Symptoms of radiation sickness

> nausea
> vomiting
> headache
> loss of hair.
> loss of white blood cells.

- Half of all people exposed to 450 rems die or will die eventually due to cancer or leukemia
- doses of 800 rems or more are always fatal.

1000 mrem = 1 rem

Typical US Citizen for 1 year

Radiation Source	Amount of Rem
standing outside at-sea level	26 mrem
food	20 mrem
simple x-ray dental x-ray	1 mrem
hip Xray	65 mrem
CAT Scan	110 mrem
living by a nuclear power plant	0.02 mrem

Unstable nuclei are considered radioactive

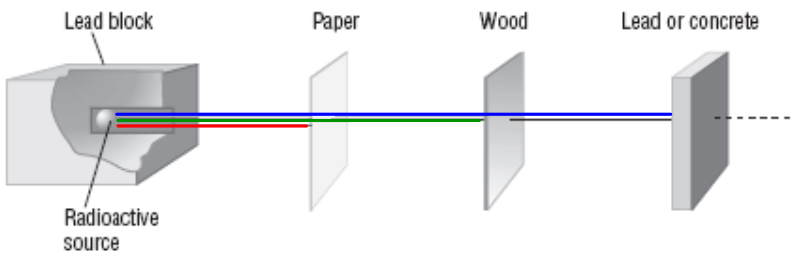
Unstable isotopes are called radioisotopes

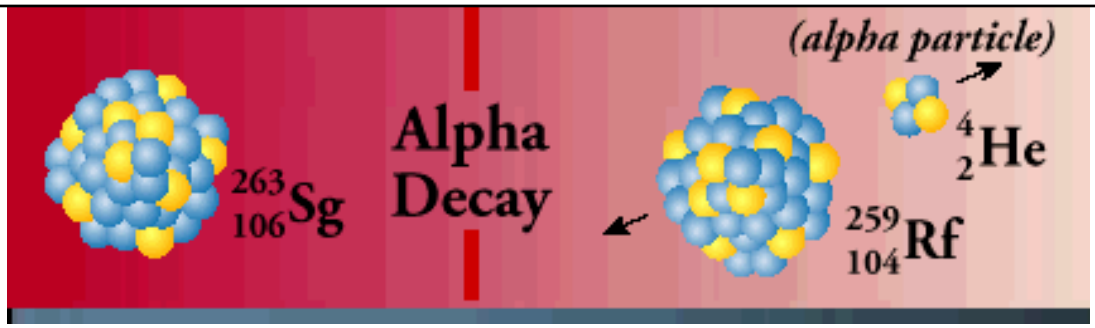
Radioactive Decay occurs as these nuclei break down into simpler elements/particles

Transmutation is the process of radioactive decay occuring

3 types of Decay: α β γ

Alpha Beta Gamma





Alpha decay results in the loss of a Helium nucleus from an isotope.

Mass # (p + n) → ^{4}He

Atomic # (protons) → 2

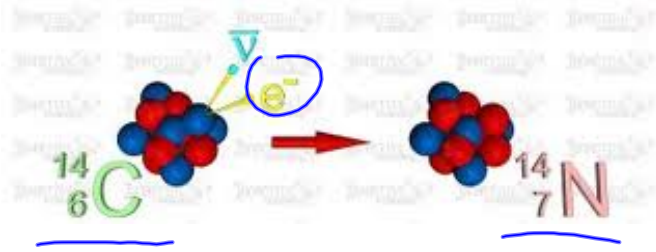
Show the products of Alpha decay of the following

Plutonium-238 $^{238}_{94}Pu \xrightarrow{\alpha} {}^{4}_{2}He + {}^{234}_{92}U$

Polonium-214 $^{214}_{84}Po \xrightarrow{\alpha} {}^{4}_{2}He + {}^{210}_{82}Pb$

Radium-220

Radon-219



Beta decay, a proton is added & and a electron is released

$$^{14}_{6}C \xrightarrow{\beta} {}^{14}_{7}N + {}^{0}_{-1}e$$

Write the Equation for the beta decay of the following:

Thoruim-234

$$^{234}_{90}Th \xrightarrow{\beta} {}^{234}_{91}Pa + {}^{0}_{-1}e$$

Chromium-55,

$$^{55}_{24}Cr \xrightarrow{\beta} {}^{55}_{25}Mn + {}^{0}_{-1}e$$

Radioactive Half-Life

A period of time in which half the nuclei (sample) of a radioactive isotope will decay

Sample Problem

The half-life of Sodium-24 is 15 hours.

- This means that 1/2 of the Sodium-24 will decay in 15 hrs.
- How much would you expect to be left after 45 hours if you started with 200 grams?

Formula

$$\frac{\text{time elapsed}}{\text{1/2 life}} = \text{how many times to divide mass by 2}$$

("how many ½ lives have elapsed" (n))

$\frac{45}{15} = 3 = n$ $\quad mass\left(\frac{1}{2}\right)^n \quad m_o\left(\frac{1}{2}\right)^n$

$200\left(\frac{1}{2}\right)^3 = 25\,g$

The half-life of $^{241}_{95}Am$ is 458 years. How much of a 12.0 g sample would remain after 1374 years?

$\frac{ET}{HL} = n \quad ; \quad m_o\left(\frac{1}{2}\right)^n$ (m_o = initial mass)

$\frac{1374}{458} = 3 = n \quad 12g\left(\frac{1}{2}\right)^3 = 1.5\,g$

How is half-life information used in carbon dating?

The half-lives of certain types of radioisotopes are very useful to know. They a us to determine the ages of very old artifacts. Scientists can use the half-life of Carbon-14 to determine the approximate age of organic objects less than 40,000 years old. By determining how much of the carbon-14 has transmutated, scientist can calculate and estimate the age of a substance. This technique is known as **Carbon dating**. Isotopes with longer half-lives such as Uranium-238 can be used to date even older objects