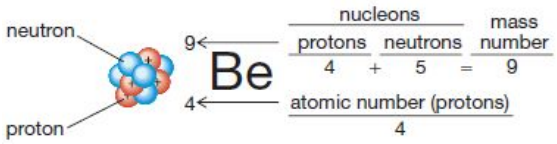
Science 30	Unit D: Energy and the Environment
Lesson 9 - Nuclear Energy	84 mins

Nuclear Energy

- Potential Energy within the nucleus Two Types - Fusion - combining of Nucleus - Fission - Splitting of the Nucleus	Described in physics as the weak and strong forces of an atom Draw Draw

Describing the Nucleus

- Made up of protons (+) and neutrons (n) Definitions - proton: a component of an atomic nucleus with a mass of 1 atomic mass unit and a charge of 1+ - neutron: a component of an atomic nucleus with a mass of 1 atomic mass unit and no net charge - nuclear notation: representation of an atom, ${}^{A}_{Z}X$, that lists the chemical symbol for the element (X), its atomic number (Z) (electrical charge of the nucleus), and its mass number (A) - atomic number: the number of protons in the nucleus of an atom; determines the identity of an element - mass number: the total number of protons and neutrons in an atom; frequently written after the name of an element to identify a specific isotope - nucleon: the name applied to protons and neutrons (the parts of an atom's nucleus) - isotope: a particular variety of an element as defined by its atomic mass	Draw 

Types of Radiation

Some isotopes are stable, and others are unstable. Unstable isotopes will decay, changing some nucleotides.

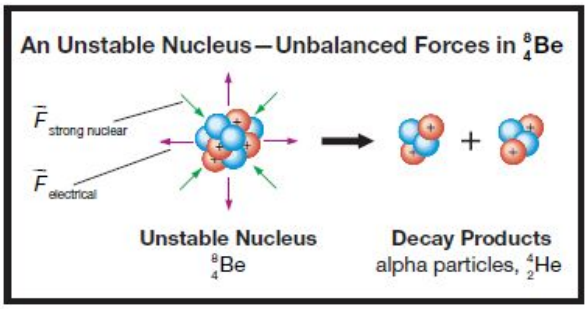
Alpha - making of helium nuclei from nuclear decay

- radioactive decay: a spontaneous change in which an unstable nucleus emits radiation

Example

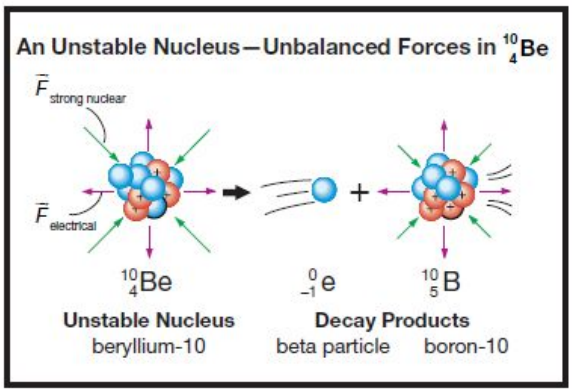
$$^{241}_{95}Am \rightarrow {}^{4}_{2}He + {}^{A}_{Z}X$$

$$^{A}_{Z}X = {}^{237}_{93}X \quad \therefore \text{ X = Np (atomic number = 93)}$$



TOPS must add up
BOTTOMS must add up

Beta - the making of electrons from nuclear decay



Example

$$^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{A}_{Z}X$$

$$^{A}_{Z}X = {}^{14}_{7}X \quad \therefore \text{ X = N (atomic number = 7)}$$

TOPS must add up
BOTTOMS must add up

Gamma - the making of a photon

Antimony-126, a beta particle, and a gamma photon are the three products of a nuclear reaction.

$$^{A}_{Z}X \rightarrow {}^{0}_{0}\gamma + {}^{0}_{-1}e + {}^{126}_{51}Sb$$

$$^{A}_{Z}X = {}^{126}_{50}X \quad \therefore \text{ X = Sn (atomic number = 50)}$$

$$^{60}_{27}Co \rightarrow {}^{0}_{0}\gamma + {}^{0}_{-1}e + {}^{60}_{28}Ni$$

Other “Weirder” Radiation

Positron Radiation - the production of an ANTI-electron	$^{0}_{+1}e$ = positively charged electron
Anti-Protons - negatively charged protons	$^{1}_{-1}p$

Science 30 - Lesson 45 - Unit D - Nuclear Energy

Name: _____

1) Complete the following table.

Isotope	Atomic Number	Mass Number	Number of ...		
			Protons	**Neutrons**	**Nucleons**
Hydrogen-2 (Deuterium)					
Carbon-13					

2) The masses of a proton, neutron, and an electron are as follows:
proton: 1.007×10^{-3} kg/mol neutron: 1.008×10^{-3} kg/mol electron: 5.49×10^{-7} kg/mol
   a) How many times larger are protons than electrons?

   b) It is customary to ignore the mass of electrons when calculating the atomic mass. Use your answers to a. to justify this practice.

3) Using nuclear notation, express the following isotopes.

uranium-235	uranium-238	polonium-210	polonium-218

4) Each isotope listed undergoes beta decay. Write a balanced nuclear equation showing the change that occurs.
    a) Krypton-87

    b) Silicon-32

5) Each isotope listed is a product of beta decay. Use a balanced nuclear equation to determine the identity of the isotope that underwent nuclear change.
    a) gallium-71

    b) nickel-60

6) Polonium-218 emits an alpha particle and a gamma photon. Identify the other product of the decay of polonium-218.