Nuclear reactions

- Nuclear reaction is a change that affects the **nucleus** of an atom.
- The amount of energy released is calculated by the equation $E=mc^2$.

  E = energy; m = mass; c = speed of light (Electromagnetic waves)

Predicting Type of Decay

- Alpha decay occurs primarily in heavy nuclei ($A > 200$, $Z > 83$).
- Beta minus decay is observed in nuclides with a large N:P ratio (too many neutrons)
- Beta plus (positron) decay occurs with a large P:N ratio (too few neturons)
  - A **positron** is the antiparticle of the electron, i.e. it has a **+1** charge and the same mass as an electron.

Writing a nuclear reaction equation

- Use chemical symbol with the **mass number** and **atomic number** for isotopes involved

  - The symbol for Uranium-238 = $^{238}_{92}U$
- Symbols are also utilized to represent alpha and beta particles (or neutrons).

  - The symbol for an alpha particle = $^{4}_{2}He$
  - The symbol for a beta-minus particle is $^{0}_{-1}e$
  - The symbol for a beta-plus particle is $^{0}_{+1}e$
  - The chemical symbol for a neutron = $^{1}_{0}n$

- Uranium-238 is an isotope, which undergoes alpha decay to produce Thorium and gamma rays. This is expressed mathematically by the following equation:

$$^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He + \text{gamma rays}$$

- Note that when the mass numbers on each side of the equation are added together that they are equal.
- The same principle is true for the atomic numbers, and it shows that none of the atomic particles have been lost.
- One way to check to see if you have written the proper nuclear equation is to make sure both sides of the equation have the same number or atomic particles represented