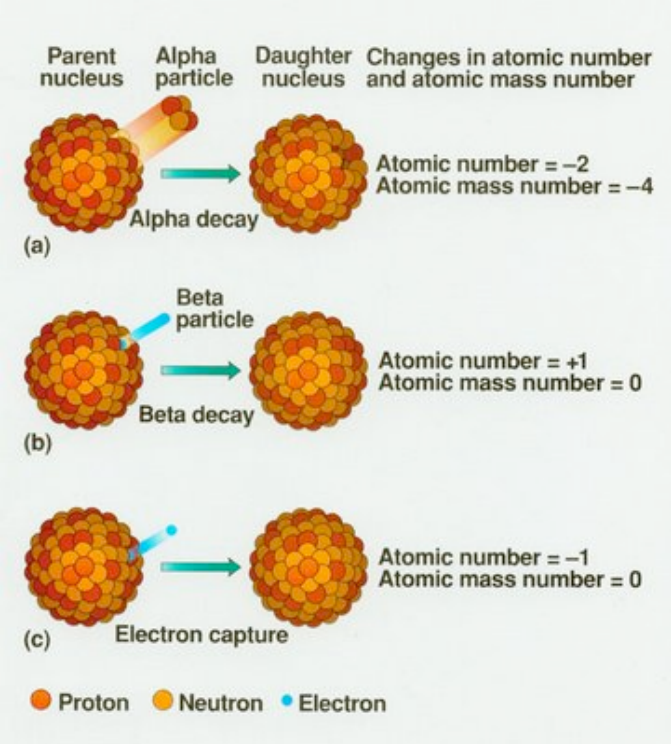
Absolute Time

Relative dating helps to place events or layers in a sequence. Other methods must be used to determine the actual dates of events – **absolute time**.

Radioactive decay occurs when radioactive isotopes (elements which have more neutrons than the more common isotope (C-14 vs. C12) AND are unstable) will emit or capture tiny particles in a process called radioactive decay. There are three main types of decay:

i. alpha decay; an alpha particle, composed of 2 protons and 2 neutrons (similar to a helium atom, but without electrons), is emitted.
ii. beta decay; a neutron breaks apart to form a proton and an electron, the electron is emitted.
iii. electron capture; a proton captures an electron and becomes a neutron. This is a mode of decay because the atomic number is reduced by one.

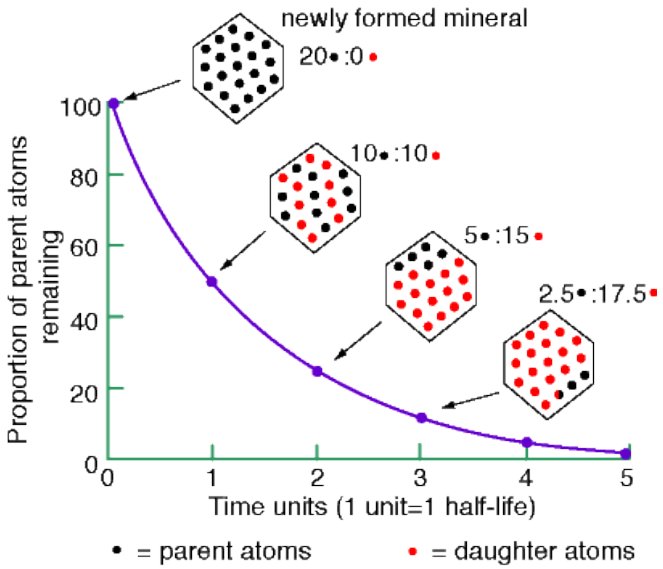


Each time a particle is emitted or captured, the isotope's atomic number changes and it becomes an isotope of a different element. If the new element is still radioactive (unstable), decay continues until a stable isotope (non-radioactive) is reached. The original element is called the parent isotope and the product after the decay process is called the daughter isotope.

Half-life:

Radioactive elements decay at constant rates that are not effected by changes in temperature or pressure. At the moment when a piece of Canadian Shield (igneous rock) crystalizes, radioactive elements in the rock begin to decay. The ratio of radioactive element left as compared to the amount of stable product can be used to determine the absolute age.

The rate at which an element decays is known as their half-life. A half-life is the amount of time it takes for $\frac{1}{2}$ the radioactive elements in a sample to decay to a stable product. Geologists use radiometric dating (making a ratio of the amount of parent and daughter isotope within a rock to determine the age of the rock)



Examples of Radiometric Dating used by geologists:

Parent Isotope	Daughter Isotope	Half-life	Effective Dating Range	Details
Carbon-14	Nitrogen-14	5730 yrs	100 to 70000 years	Carbon-14 is formed in the atmosphere of the earth and then absorbed by plants by photosynthesis or animals when they eat plants. Only useful for once living things, not rocks.
Uranium-238	Lead-206	4.5 billion yrs	10 million to 4.6 billion years	Limitation is that it can only be used to date rocks which contain the zircon mineral (not a common mineral in igneous rocks
Potassium-40	Argon-40	1.3 billion yrs	50000 to 4.6 billion years	Used to date a number of different igneous rocks
Rubidium-87	Strontium-87	47 billion yrs	10 million to 4.6 billion years	Rubidium is found in common minerals such as feldspars and micas. Therefore most igneous rocks could be aged by determining how much of the Rubidium has decayed into Strontium