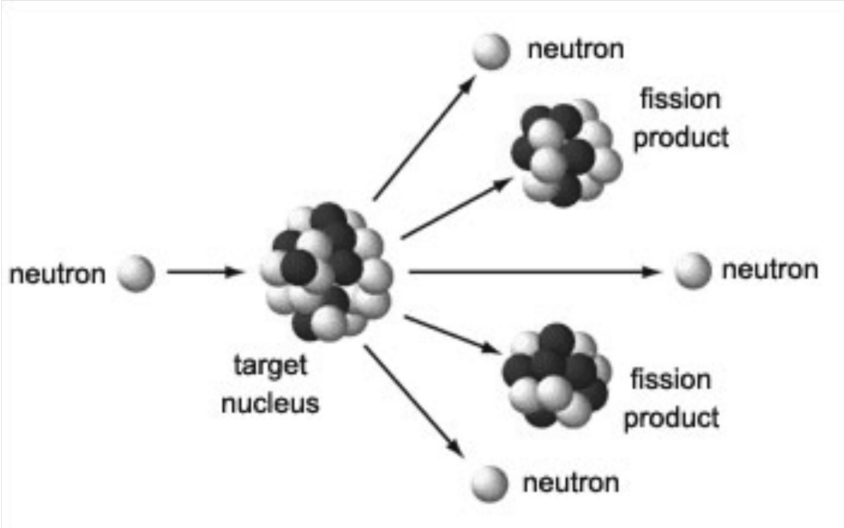
Nuclear Chemistry



The main points of nuclear chemistry are:

1. Stable isotopes vs. unstable ones.
2. The unstable isotopes emit radiation in an attempt to become "more stable".
3. Radiation can be particles, or energy, or both. Table O lists the 6 radiation types in high school chemistry.
4. Each particle has different charge, mass, and penetrating power.
5. Unstable isotopes will change into, or transmute, by emitting radiation from their nuclei. They change their proton to neutron ratios. This process occurs a certain way for each type of radioisotopes emit only one kind of radiation. It occurs at a certain rate, called the half life. It takes a specific amount of time for one half of a radioisotope sample to transmute into new elements. That process is set, and can't be speeded up or slowed down by humans.
6. We can do math to predict how much of a radioisotope will be left after a period of time, or we can know the fraction of the whole amount we started with, or we can determine how much was once present if we know how much we have now. Table N shows us half life, and also the mode of radioactive decay 25 different radioisotopes undergoes.
7. Transmutations can be natural, or humans can force them artificially.
8. Two types of nuclear reactions are fission (the splitting of atoms) and fusion (the squishing of two smaller atoms into one larger one). Both release enormous amounts of energy, much more than combustion. Fission runs power plants and is in smaller nuclear bombs, and it can be controlled by humans. Fusion is uncontrollable by humans, but is used in hydrogen bombs. The Sun undergoes fusion as well.
9. In both fission and fusion, small amounts of matter are turned into energy, there IS a loss of matter. Nucellar chemistry is not the same as chemistry, the law of conservation of matter does not hold true. Albert Einstein did show a way to account for this with his formula $e = mc^2$, whereby energy equals matter (multiplied by the speed of light squared, a constant). Although matter is converted to energy, scientists can account for this.
10. Nuclear power is used by humans to produce electricity. Although it does not produce green house gases, and when the plants run well, it works pretty well, accidents are catastrophic. The production of radio-active wastes are a long term problem, as they have to be stored (sometimes for tens of thousands of years) to be kept out of the environment, or terrorists hands. These wastes can't trigger a nuclear explosion, but they can spread radiation, which is toxic, and create unsafe areas.
11. Scientists have learned to use radiation to treat diseases like cancer (Co-60 produces beta radiation which can be aimed at tumors to kill them). I-131 can be injected in small quantities to measure the iodine absorption by our thyroid glands. Am-241 and 243 are used in smoke detectors. C-14 can be used to date once living materials (plants and animals) fairly accurately to about 100,000 years. All radiation is toxic to humans, so limiting exposure is always best. There is naturally occurring radiation on Earth, specifically radon gas seeps from the ground, and many houses have vents to blow it from under house foundations.