Natural Transmutation vs Artificial Transmutation

When a **radioisotope** (an isotope that is radioactive) spontaneously decays into a different element and another particle, it is called **transmutation**. **Natural Transmutation** is when a radioactive substance such as C-14 or N-16 decay on their own in nature. There is only one "reactant."

Ex: $^{13}_{53}I \rightarrow {}^{0}_{-1}e + {}^{13}_{54}Xe$

Artificial transmutation is when scientists cause a radioisotope decay in a lab by forcing it to collide with small particles like neutrons.

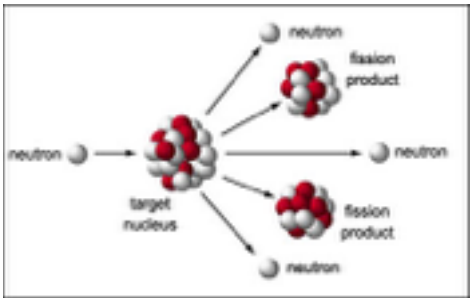
Ex: $^{23}_{94}Pu + {}^{1}_{0}n \rightarrow {}^{23}_{94}Pu + 2\,{}^{0}_{-1}e$

Two types of artificial transmutation: Fission and Fusion

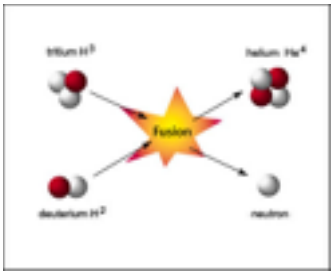
Nuclear fission: a nuclear reaction in which the nucleus of a particle splits into smaller parts (lighter nuclei). Fission sounds like division: a large atom divides into smaller atoms

The fission process often produces free neutrons and gamma rays which contain a very large amount of energy. For example, U-235 is used in nuclear powerplants.

$$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n$$



Nuclear fusion: **nuclear fusion** is a nuclear reaction in which two or more atomic nuclei collide at a very high speed and join to form a new type of atomic nucleus. **Fusion means "to join," like a latin fusion restaurant combining Latin and Asian foods.** During this process, matter is not conserved because some of the mass of the fusing nuclei is converted to photons (energy). We haven't learned how to obtain energy from fission yet, but it would be safer than nuclear fusion because it does not make nuclear waste.



ANSWER THIS QUESTIONS ON YOUR WORKSHEET

1. During **natural transmutation**, how many reactants are used?

2. During **artificial transmutation**, how many reactants are used?

3. What is the difference between **natural transmutation** and **artificial transmutation**?

4. How can you remember that in a **fission reaction**, one atom break apart into smaller atoms?

5. Which is an example of **nuclear fission**?

(a) $2H_2O_2 \rightarrow 2H_2O + O2$

(b) $2HCl + 2Mg \rightarrow 2MgCl + 1H_2$

(c) $^{238}_{92}U + {}^{1}_{0}n \rightarrow {}^{239}_{94}Pu + 2\,{}^{0}_{-1}e$

(d) $^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

6. Which is an example of **nuclear fusion**?

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7. Why would **fusion** be a safer way of producing energy than **fission**?