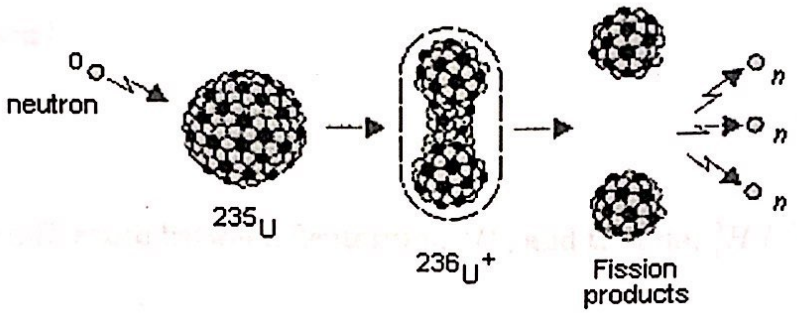
Name: _____

Model Fission + Fusion

1. Fission

The process of fission occurs when a nucleus splits into smaller pieces. Fission can be induced by a nucleus capturing slow moving neutrons, which results in the nucleus becoming very unstable.



(http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch23/fission.html)

The following equations represent fission reactions, where n = neutron.

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

$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{137}_{52}Te + {}^{97}_{40}Zr + 2\,{}^{1}_{0}n$

$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{152}_{60}Nd + {}^{81}_{32}Ge + 3\,{}^{1}_{0}n$

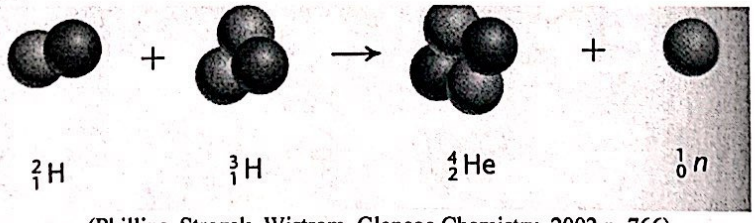
$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{131}_{50}Sn + {}^{103}_{42}Mo + 2\,{}^{1}_{0}n$

$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{138}_{54}Xe + {}^{95}_{38}Sr + 3\,{}^{1}_{0}n$

(Not always Uranium)

2. Fusion

Fusion occurs when 2 nuclei join together to form a larger nucleus. Fusion is brought about by bringing together two or more small nuclei under conditions of tremendous pressure and heat.



* Focus on Mass #!

(Phillips, Strozak, Wistrom, Glencoe Chemistry. 2002 p. 766)

The following equations represent fusion reactions

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

$^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + 2\,{}^{1}_{1}H$ (Rare)

(Not always H + He)

Key Questions

1. What is fission?

2. What is fusion?

3. What is the difference between deuterium, ${}^{2}_{1}H$, and tritium, ${}^{3}_{1}H$? (Be specific!)

4. What quantities are conserved in a nuclear transmutation?

5. The fusion equations show the production of atoms of several different elements, even though each reaction begins with isotopes of hydrogen. Knowing the starting elements, can one *predict* what element will form as a result of a given reaction? Explain why or why not.

6. The fission equations show the production of many different elements, even though each reaction begins with uranium-235 and one neutron. How is this possible given the conservation laws for nuclear reactions?

Exercises

1. An equation in the model could show the fusion of two deuterium nuclei to form a nucleus of tritium. Suggest another product that might form in this reaction.

$^{2}_{1}H + {}^{2}_{1}H \rightarrow$ _____

2. Describe *how* to find the identity of the species X in the equation

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{152}_{60}Nd + \underline{X} + 3\ {}^{1}_{0}n.$$

3. What is missing in the following reaction?

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow \_\_\_\_\_ + {}^{90}_{37}Rb + 2\ {}^{1}_{0}n$$

4. An atom of U-235 absorbs a neutron and produces an atom of Sb-125 and four neutrons. Identify the other nuclide formed in this reaction. Write the equation to support your answer.

5. Identify the following equations as fission or fusion.

	Fission or Fusion?
$^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{1}H + {}^{1}_{1}p$	
$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\ {}^{1}_{0}n$	
$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{138}_{54}Xe + {}^{95}_{38}Sr + 3\ {}^{1}_{0}n$	
$^{3}_{2}He + {}^{3}_{2}He \rightarrow {}^{4}_{2}He + 2{}^{1}_{1}H$	

Research

1. What is the source of energy in fusion and fission reactions? Explain your answer.

2. Name one problem associated with the use of nuclear energy and briefly explain why it is a problem. Also identify how that problem might be addressed.

3. During the 1950's, when many countries performed above ground tests of nuclear weapons, there was much concern about the radioactive fallout when the by-products of uranium fission landed on populated areas. One major concern dealt with the fallout of radioactive strontium isotopes and a suspected link to increases in leukemia and bone cancer. What part of the body might absorb strontium? Explain your answer. (5)