

Name _____

Date _____

Student Exploration: Nuclear Reactions

After to teachers and students: This Gizmo was designed as a follow-up to the Nuclear Decay Gizmo. The movement along the activity button brings this one.

Key vocabulary: chain reaction, CNO cycle, catalytic, deuterium, electron volt, fission, fusion, isotope, nuclear reaction, neutron, proton emission, proton-proton (pp) chain reaction, thermal neutron, number of protons, neutron

Prior Knowledge Questions (Please REROLL using the Gizmo.)

The chart is to the right gives the following

mass, atomic number, number of protons, and

number of neutrons of these isotopes.

1. What do you notice about the isotope number and the sum of protons and neutrons?

2. Click the button for isotope ^{238}U . This nucleus has a total mass of 238 and contains 146 protons. Write the element symbol for the isotope in the box.

Hydrogen-1 ^1H Carbon-12 ^{12}C Uranium-238 ^{238}U

3. The element symbol for isotope ^{238}U is ^{238}U . This nucleus has a total mass of 238 and contains 146 protons. Write the element symbol for the isotope in the box.

Hydrogen-1 ^1H Carbon-12 ^{12}C Uranium-238 ^{238}U

Game Warm-up

The Nuclear Reaction Gizmo simulation is a particle accelerator. Particle acceleration is used to allow for very high velocities. Then, the atom is impacted with enough energy to cause charged nuclear reactions. There are three particle beams available in the Gizmo: protons, neutrons, and helium-3 nuclei.

1. Click the Proton to engage the first particle beam.

What happens? Nothing. And after a few seconds, the beam disappears.

2. Clicking particles don't always meet. Click Reset, and then click the neutron.

A. Does a reaction occur? NO

B. Explain Nothing. And after a few seconds, the beam disappears.

Activity A Proton-proton	Click the Gizmo first		Reaction H + H → H + H	H + H → H + H
	Click Reset	Is any Proton-proton is selected in the Reaction		

Introduction: At 100 km hydrogen isotope fusion is a process called nuclear fission. 2001 performs this process in different ways. In this Gizmo, the proton-proton chain is used. This reaction requires approximately greater than 4,000,000 eV to occur.

Question: How does the process of fusing two hydrogen into helium in stars?

1. Observe Click the proton and observe. What happens after the proton carries the nucleus? $^1\text{H} + ^1\text{H} \rightarrow ^2\text{H} + ^1\text{e}$ $^1\text{H} + ^1\text{H} \rightarrow ^2\text{H} + ^1\text{e}$

2. $^1\text{H} + ^1\text{H} \rightarrow ^2\text{H} + ^1\text{e}$

3. Observe Click Reset and click the proton. Observe what happens. Many additional particles appear (neutrinos) in nuclear reactions. Their element symbols are given below.



(Neutrons ^1H are also produced but are beyond the scope of this Gizmo.)

Click Reset and click the proton. Look at the Helium equation description. Based on what you have observed, write in the equation for this reaction in the Gizmo and below.



A. Turn on the equation. Was your predicted equation correct? YES

Correct your equation if necessary. The resulting ^3He isotope is short lived helium.

B. Unbond energy is released in this reaction with ^3He , where the He is equal to

the Helium-3 nucleus. How much energy is emitted in this reaction? 14.7 MeV

(Activity A continued on next page)

Answer Guide To Nuclear Chemistry

Gary S. Thorpe

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