

Name _____

Date _____

Student Exploration: Nuclear Reactions

Role to teachers and students: This Gizmo was designed as a follow-up to the Nuclear Decay Gizmo. We recommend doing this activity before trying the one!

Vocabulary: chain reaction, CNO cycle, catalyst, deuterium, electron volt, fusion, fusion, isotopes, nuclear reaction, positron, positron emission, proton-proton chain

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
The chart to the right gives the **atomic mass**, **element symbol**, **number of protons**, and **number of neutrons** of three isotopes.

Isotope	Protons	Neutrons
Hydrogen-1	1	0
Carbon-12	6	6
Uranium-235	92	143

- What do you notice about the atomic number and the sum of protons and neutrons?

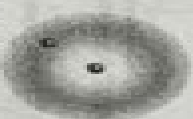
Hydrogen is 1 amu

- The element symbol for uranium-235 is $^{235}_{92}\text{U}$. This means U-235 has a total mass of 235 and contains 92 protons. Write the element symbols for the isotopes in the table.

Hydrogen-1 ^1_1H Carbon-12 $^{12}_6\text{C}$ Uranium-235 $^{235}_{92}\text{U}$

Gizmo Warm-up

The Nuclear Reactions Gizmo simulates a particle accelerator. Particle accelerators speed up atoms to very high velocities. Then crash the atoms together with enough energy to cause changes called **nuclear reactions**. There are five particle beams available in the Gizmo: protons, neutrons, and neutrinos.



- Click the **Protons** to engage the first particle beam.

What happens?

Neutrons and it's in the Uranium

- Clicking particles don't always react. Click **Reset**, and then click **Fire neutrons**.

A. Does a reaction occur? NO

B. Explain. Neutrons should react

Activity A	Get the Gizmo ready	
Proton-proton chain	<ul style="list-style-type: none"> Click Reset Be sure Proton-proton is selected in the Reaction type. 	<input checked="" type="radio"/> Protons <input type="radio"/> Neutrons

Introduction: All stars turn hydrogen into helium in a process called **nuclear fusion**. Stars perform this process in different ways. In stars like our sun, the **proton-proton chain** is used. The reaction requires temperatures greater than 1,000,000 K to occur.

Question: How does the process of fusion turn hydrogen into helium in stars?

- Clicking **Click Fire protons** and observe. What happens after the protons merge for the second? Protons and neutrons form

2. Helium

This is a form of nuclear decay called **positron emission**. During positron emission, a proton decays into a neutron. In this process, it emits a **positron**, which is a nearly massless antiparticle with a positive charge.

- Clicking **Click Reset** and click **Fire protons**. Observe what happens. Many individual particles appear frequently in nuclear reactions. Their element symbols are given below:

Neutrons	Protons	Electrons	Positrons
^1_0n	$^1_1\text{p}^+$	$^0_{-1}\text{e}^-$	$^0_{+1}\text{e}^+$

(Positrons $^0_{+1}\text{e}^+$ are also produced but are beyond the scope of this Gizmo.)

Click **Reset** and click **Fire protons**. Turn on the **Write equation checkbox**. Based on what you have observed, write in the equation for this reaction in the Gizmo and below.



- Turn on **Show equation**. Was your predicted equation correct? YES

Correct your equation if necessary. The resulting H-2 isotope is called **deuterium**.

- Enacted energy is reported in megaelectron volts (MeV), where one MeV is equal to one million **electron volts**. How much energy is emitted in this reaction? 1.44 MeV

(Activity A continued on next page)

Answer Guide To Nuclear Chemistry

Gary S. Thorpe



Answer Guide To Nuclear Chemistry:

Study Guide for Chemical Principles Thomas Elliott Taylor, 1979 **Kaplan SAT Subject Test Chemistry 2015-2016**
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Pressley, 2002 A quiz game designed to reinforce key chemistry concepts ideas and facts **General Chemistry Workbook** Daniel C. Tofan, 2010-07-28 This workbook is a comprehensive collection of solved exercises and problems typical to AP introductory and general chemistry courses as well as blank worksheets containing further practice problems and questions It contains a total of 197 learning objectives grouped in 28 lessons and covering the vast majority of the types of problems that a student will encounter in a typical one year chemistry course It also contains a fully solved 50 question practice test which gives students a good idea of what they might expect on an actual final exam covering the entire material

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Kaplan SAT: Chemistry Claire Aldridge,Karl Lee,2006-02 Includes 3 Full length practice tests Comprehensive review of all the tested material with practice quizzes for each chapter Effective strategies to maximize your score

The Book Exchange ,1956

Modern Nuclear Chemistry Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg, 2017-04-10 Written by established experts in the field this book features in depth discussions of proven scientific principles current trends and applications of nuclear chemistry to the sciences and engineering Provides up to date coverage of the latest research and examines the theoretical and practical aspects of nuclear and radiochemistry Presents the basic physical principles of nuclear and radiochemistry in a succinct fashion requiring no basic knowledge of quantum mechanics Adds discussion of math tools and simulations to demonstrate various phenomena new chapters on Nuclear Medicine Nuclear Forensics and Particle Physics and updates to all other chapters Includes additional in chapter sample problems with solutions to help students Reviews of 1st edition an authoritative comprehensive but succinct state of the art textbook The Chemical Educator and an excellent resource for libraries and laboratories supporting programs requiring familiarity with nuclear processes CHOICE

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