Power From Nuclei

Compare nuclear reactions and their uses.

PHS.4.5 "Research nuclear reactions and their uses in the modern world, exploring concepts such as fusion, fission, stars as reactors, nuclear energy, and chain reactions."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline what happens to nuclei in each reaction, circle two present-day uses, and write 1 beside a way to control a reaction and 2 beside a challenge of nuclear energy.

From Reactor to Star

1 At night, a hospital needs steady electricity. A nuclear power plant can supply some of it by splitting uranium nuclei in a controlled reactor. When one nucleus splits, it releases energy and neutrons. Some neutrons split other nuclei, creating a chain reaction. Control rods absorb extra neutrons, slowing the reaction. Heat from fission makes steam that turns a turbine.

2 The Sun runs on a different nuclear reaction. Gravity compresses hydrogen in its hot core, where hydrogen nuclei join through several steps to form helium and release energy. This is fusion. On Earth, engineers use magnetic fields to confine hot fuel in experimental fusion machines. No fusion plant currently supplies commercial electricity.

NUCLEAR REACTIONS IN DIFFERENT SETTINGS

Setting	Reaction	Outcome
Power plant	Fission	Electricity
Research reactor	Fission	Medical isotopes
Sun	Fusion	Sunlight

3 Nuclear reactions have uses beyond power generation. Some research reactors produce radioactive isotopes used in medical imaging and cancer treatment. Electricity from fission plants is generated with very low direct carbon dioxide emissions, but spent fuel remains radioactive and needs secure storage. Comparing benefits and risks matters when communities decide which energy sources to use.

2 ANSWER WITH EVIDENCE

Use the passage

1. How do the changes to nuclei differ in a power plant and in the Sun?

2. Why can one uranium nucleus splitting lead to more nuclei splitting, and how can the reaction be slowed?

3. A hospital needs electricity and medical isotopes. According to the table, which setting provides each, and what reaction does each use?

4. What benefit and what challenge should a town weigh when considering a fission power plant?

3 YOUR TURN

Your own words

A post claims, "A fusion plant could power our town next year because the Sun uses fusion." Write three sentences that identify what is true, explain why the prediction is unsupported, and compare how the Sun and an Earth machine hold their fuel.

Power From Nuclei

PART 1 · READ AND MARK

Underline what happens to nuclei in each reaction, circle two present-day uses, and write 1 beside a way to control a reaction and 2 beside a challenge of nuclear energy. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How do the changes to nuclei differ in a power plant and in the Sun?	**A power plant splits uranium nuclei by fission. In the Sun, hydrogen nuclei join through fusion to form helium.**
2	Why can one uranium nucleus splitting lead to more nuclei splitting, and how can the reaction be slowed?	**Splitting releases neutrons that can split other nuclei. Control rods absorb extra neutrons, slowing the chain reaction.**
3	A hospital needs electricity and medical isotopes. According to the table, which setting provides each, and what reaction does each use?	**A power plant provides electricity through fission. A research reactor produces medical isotopes through fission.**
4	What benefit and what challenge should a town weigh when considering a fission power plant?	**The plant generates electricity with very low direct carbon dioxide emissions, but its radioactive spent fuel needs secure storage.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The Sun does release energy when hydrogen nuclei fuse to form helium. Fusion machines on Earth are still experimental, and no fusion plant currently supplies commercial electricity, so the post does not support its prediction. Gravity compresses fuel in the Sun, while engineers use magnetic fields to confine hot fuel on Earth.

Accept equivalent wording that distinguishes splitting from joining nuclei. For the fact-check, look for all three requested points without requiring students to predict when commercial fusion will become available.