Fission and a model chain reaction

Student activity • observation and reasoning

YEAR 11 / LESSON 101 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How can neutrons released by one fission lead to further fissions?

Use paper nuclear symbols and a branching diagram to explain a chain reaction without physical projectiles.

Equipment

- Booklet, original nuclear-symbol cards and coloured pencils

Paper models only. No radioactive materials, projectiles, mousetraps, flames or explosive demonstrations are used.

Course coverage: Shared Physics / Double Award: 7.17–7.20. Neutron-induced fission, products and chain reactions.

Plan, model or apparatus sketch

Draw a labelled nuclear or astronomical model and state its limits.

Method and reasoning

Read the whole sequence before starting

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1. Represent a uranium-235 nucleus absorbing one neutron. Add nucleon and charge numbers to show the combined excited system has A = 236 and Z = 92.

2. Use one illustrative product channel: barium-141 with Z = 56, krypton-92 with Z = 36, and three neutrons. Check total A and Z on both sides.

3. Draw arrows showing kinetic energy carried by the fragments and neutrons. Explain that radioactive fragments may later decay and contribute further energy.

4. Draw a branching model in which some emitted neutrons cause another fission, some are absorbed without fission and some escape. Label these alternatives rather than assuming every neutron succeeds.

5. Compare diagrams with fewer than one, about one and more than one continuing fission on average per preceding fission. Explain decreasing, approximately steady and increasing model rates qualitatively.

6. State limitations: product pairs vary, neutron interactions are probabilistic, and a diagram is not a design or operating model of a reactor.

Cleanup

- Collect cards and retain balanced diagrams.

Record your evidence

Blank spaces are for your own work

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Reference and task data

One balanced example is U-235 + neutron → Ba-141 + Kr-92 + 3 neutrons. A totals 236 and Z totals 92. Many different fission products occur; this example is not the unique channel.

Part of model	Nucleon / charge check	Explanation
Incoming nucleus + neutron		
Two fragments		
Emitted neutrons		
Continuing / lost neutrons		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. What initiates the stated fission?

2. Find the total incoming nucleon number.

3. Check 141 + 92 + 3.

4. Check 56 + 36.

5. Why is not every emitted neutron part of a continuing chain?

6. Where is much of the immediate released energy?