Reactor roles and energy transfer

Student activity • observation and reasoning

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The question

Why do a moderator, control rods and shielding have different jobs?

Label a simplified thermal-reactor diagram and trace energy transfers without treating it as an engineering plan.

Equipment

- Booklet, original reactor-role cards and ruler

Desk-based diagram activity. No heat source, pressurised system, radioactive material or reactor equipment is used.

Course coverage: Shared Physics / Double Award: 7.17, 7.21–7.22. Moderator, control rods, shielding and reactor energy transfer.

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. Draw a simplified thermal reactor with fuel, moderator, control rods, coolant and shielding. State that reactor designs differ and this is one conceptual model.

2. Explain the moderator's role in slowing neutrons so they are more likely to cause further fission in the stated thermal-reactor model.

3. Explain how control rods absorb neutrons and influence the fission rate. Distinguish absorbing neutrons from slowing them.

4. Explain shielding as reducing radiation reaching outside regions. Keep shielding distinct from coolant, whose role is transferring energy away from the fuel.

5. Trace energy through coolant or a heat exchanger to steam, turbine and generator in a simplified electricity-generation system. Include unwanted thermal transfer to the surroundings.

6. Explain why cooling remains necessary after the fission chain is stopped: radioactive decay of products continues to release energy. Do not equate shutdown with instant disappearance of heat or radioactivity.

Cleanup

- Retain the labelled system and collect cards.

Record your evidence

Blank spaces are for your own work

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Reference and task data

This is a conceptual thermal-reactor model. The moderator and coolant may be the same material in some designs but perform different functions. Control rods, shielding and cooling are not interchangeable.

Component	Function	Common confusion
Moderator		
Control rods		
Shielding		
Coolant		
Turbine / generator		

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 does a moderator do?

2. What do control rods do?

3. What does shielding do?

4. What does coolant do?

5. What turns the generator in the model?

6. Why is cooling still required after shutdown?