Fusion in stars: energy and balance

Student activity • observation and reasoning

YEAR 11 / LESSON 104 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How does fusion supply a star’s energy without being chemical burning?

Build a labelled model of a main-sequence star and explain the roles of temperature, density and gravity.

Equipment

- Booklet, original star diagram and coloured pencils

Diagram lesson only. No flames, plasma lamps, pressure vessels or solar viewing are used. Never look directly at the Sun.

Course coverage: Shared Physics / Double Award: 7.17, 7.25–7.26. Stellar fusion and electrostatic repulsion.

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 main-sequence star with a hot dense core and outer layers. Label the core as the region where hydrogen nuclei are converted overall into helium through nuclear reactions.

2. Explain that positively charged nuclei repel. High temperature gives particles large kinetic energies; high density provides many close encounters. The detailed process also involves quantum effects beyond the simple collision picture.

3. Describe gravitational compression during star formation as a source of increasing temperature before sustained main-sequence fusion.

4. Draw inward gravitational effects and an outward pressure gradient in a stable star. Explain a balance in the model without claiming that every particle is stationary.

5. Trace energy from the core through the star and outward as radiation. Distinguish the core temperature from the much cooler visible surface.

6. Correct statements that the Sun burns oxygen, that fusion occurs only at its surface, or that high pressure alone removes electrostatic repulsion.

Cleanup

- Retain labelled diagrams and collect pencils.

Record your evidence

Blank spaces are for your own work

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Reference and task data

The main-sequence model concerns sustained hydrogen fusion in the core. Pressure and temperature conditions support a reaction rate; a simple school model does not calculate that rate. Do not model the Sun using a flame or pressure vessel.

Feature	Role	Misconception corrected
Core temperature		
Density		
Gravity / pressure		
Energy transfer		

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 is the main-sequence star's principal energy source?

2. Why do hydrogen nuclei repel?

3. How does high temperature help?

4. How does high density help?

5. Where does most core hydrogen fusion occur?

6. Is the Sun's energy ordinary chemical combustion?