

Stellar Forge Investigation

Compare stars of different initial masses to connect fusion, lifetime, element production, energy flow, and final stellar remnants.

NGSS: HS-ESS1-1 - model the Sun's fusion-powered energy pathway; HS-ESS1-3 - communicate how stars produce and disperse elements through their life cycles.

Name: _____

Class / Period: _____

Date: _____

Driving Question

How does a star's initial mass affect its lifetime, fusion stages, element production, and final remnant?

Before You Begin

1. Predict which star will have the shorter main-sequence lifetime: a 1-solar-mass star or a 20-solar-mass star. Explain your reasoning.

2. Predict which star will form or disperse heavier elements. Why might stellar mass matter?

Controlled Comparison - Record Three Stars

Run at least three different initial masses. A useful comparison includes a Sun-like, intermediate-mass, and massive star. Complete the life cycle before recording the final remnant.

Initial mass (M sun)	Estimated lifetime	Advanced fusion?	Heaviest modeled product	Final remnant
1.0				
5.0				
20.0				

Trace Energy Through One Fusion Stage

Step	What happens?
1. Core	
2. Interior	
3. Surface / photosphere	
4. Space / observer	

Analyze the Pattern

3. Describe the relationship between initial stellar mass and estimated main-sequence lifetime. Use at least two values from your table.

4. More massive stars begin with more fuel, yet they can have shorter lifetimes. Use the model to explain why.

5. How does increasing initial mass change the fusion stages and the heaviest modeled elements produced or dispersed?

6. How does initial mass affect the final remnant?

7. What changes on the H-R diagram as your star moves through its life cycle? Describe one pattern you observed.

Claim - Evidence - Reasoning

Claim: How does initial stellar mass control a star's life cycle and its contribution of elements to space?

Claim: State your answer in one clear sentence.

Evidence: Use at least three specific observations, measurements, or data values from the model.

Reasoning: Explain why your evidence supports the claim using the science ideas from the investigation.

Critique the Model

The model simplifies mass loss, composition, rotation, magnetic fields, binary companions, element yields, and the neutron-star/black-hole boundary. Choose one simplification and explain how it could affect a real star's outcome.
