Two Stellar Paths

Use temperature and brightness data to compare how stars change.

ESS.1A.3 "Organize and interpret data sets for patterns and trends to compare and contrast stellar evolution in order to explain and communicate how a star changes during its life."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each change in a star's stage, circle temperature and brightness comparisons, and number the stages in order for each path. Use your marks to compare how the two stars change.

What Starting Mass Changes

1. Stars begin in clouds of gas and dust. Gravity gathers material into a protostar. When its core gets hot enough, hydrogen fusion starts and the star enters its main sequence. A star's starting mass largely controls how fast it uses fuel. The table follows two possible paths; its values are rounded examples, not fixed rules.

ROUNDED EXAMPLES OF STELLAR STAGES

Path	Stage	Surface temperature (K)	Luminosity (Suns)
Sun-like	Main sequence	5,800	1
Sun-like	Red giant	3,500	100
Sun-like	White dwarf	12,000	0.003
Massive	Main sequence	30,000	100,000
Massive	Red supergiant	3,500	100,000

2. Read each path from its main-sequence row toward later stages. The Sun-like star expands into a red giant when core hydrogen runs low. It then sheds outer gas and leaves a white dwarf. The dwarf's surface can be hotter than the giant's, yet it gives off far less light because it is much smaller.

3. A massive star also expands when its core hydrogen runs low, becoming a red supergiant. Its core later collapses, causing a supernova; a neutron star or black hole may remain. Compare the rows: both expanding stars have cooler surfaces than their main-sequence forms, but neither becomes dimmer. The massive star's brightness stays especially high.

2 ANSWER WITH EVIDENCE

Use the passage

1. Order the three Sun-like stages from highest to lowest surface temperature. Does their luminosity follow the same order? Use the table to support your answer.

2. How do surface temperature and luminosity change when the massive star becomes a red supergiant? Give both pairs of values.

3. The two expanded stars have the same surface temperature in the table. How do their luminosities compare, and what does this show about using temperature alone to compare stars?

4. Compare what happens after each star's expanded stage. How does the passage connect these different paths to a star's starting mass?

3 YOUR TURN

Your own words

Write a museum label that puts both stellar paths in order and compares them. Include two numerical comparisons from the table, then explain why brightness alone may not reveal a star's stage.

ANSWER KEY

Two Stellar Paths

HIGH SCHOOL · ESS.1A.3

PART 1 · READ AND MARK

Underline each change in a star's stage, circle temperature and brightness comparisons, and number the stages in order for each path. Use your marks to compare how the two stars change. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Order the three Sun-like stages from highest to lowest surface temperature. Does their luminosity follow the same order? Use the table to support your answer.	**Temperature: white dwarf (12,000 K), main sequence (5,800 K), red giant (3,500 K). No. Luminosity is highest for the red giant (100 Suns), then the main-sequence star (1 Sun), then the white dwarf (0.003 Suns).**
2	How do surface temperature and luminosity change when the massive star becomes a red supergiant? Give both pairs of values.	**Surface temperature drops from 30,000 K to 3,500 K. Luminosity remains at 100,000 Suns.**
3	The two expanded stars have the same surface temperature in the table. How do their luminosities compare, and what does this show about using temperature alone to compare stars?	**Both are 3,500 K, but the red supergiant is 100,000 times as luminous as the Sun, compared with 100 times for the red giant. The red supergiant is 1,000 times as luminous as the red giant, so equal surface temperatures do not mean equal luminosities.**
4	Compare what happens after each star's expanded stage. How does the passage connect these different paths to a star's starting mass?	**The Sun-like star sheds outer gas and leaves a white dwarf. The massive star's core collapses in a supernova and may leave a neutron star or black hole. Starting mass helps determine how quickly fuel is used and which path a star follows.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

A Sun-like star goes from the main sequence to a red giant, then leaves a white dwarf. Its luminosity rises from 1 to 100 Suns as it expands, but the white dwarf gives off only 0.003 Suns of light. A massive star goes from the main sequence to a red supergiant, then explodes in a supernova. A neutron star or black hole may remain. The massive star has a luminosity of 100,000 Suns in both listed stages, so brightness alone cannot tell which stage it has reached.

Accept equivalent stage ordering and comparisons supported by the rounded table values. For the museum label, look for both paths in order, two accurate numerical comparisons, and a data-based reason brightness alone does not identify a stage.