



**NEW ENGLAND
COMMON ASSESSMENT PROGRAM**

**Released Items
Support Materials
2013**

**Grade 11
Science**

**NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE**

Grade 11 Science Released Item Information

Item Number	Big Idea ¹	Assessment Target	Depth of Knowledge Code	Item Type ²	Answer Key	Total Possible Points
1	INQ	PS 1-1	2	MC	C	1
2	SAE	PS 2-6	2	MC	D	1
3	INQ	PS 3-8	2	MC	C	1
4	POC	ESS 1-1	2	MC	B	1
5	POC	ESS 1-3	1	MC	D	1
6	SAE	ESS 3-8	2	MC	B	1
7	POC	ESS 1-1	2	CR		4
8	POC	LS 1-2	2	MC	C	1
9	INQ	LS 3-6	2	MC	C	1
10	FAF	LS 3-8	1	MC	A	1

Grade 11 Science Released Inquiry Task Information

Item Number	Big Idea ¹	Inquiry Construct	Depth of Knowledge Code	Item Type ²	Total Possible Points
1	INQ	12	2	SA	2
2	INQ	11	2	SA	2
3	INQ	2	3	CR	3
4	INQ	1	3	SA	2
5	INQ	8	2	CR	3
6	INQ	12	2	SA	2
7	INQ	12	3	SA	2
8	INQ	12	2	SA	2

¹Big Idea: NOS = Nature of Science, SAE = Systems and Energy, MAS = Models and Scale, POC = Patterns of Change, FAF = Form and Function, INQ = Scientific Inquiry

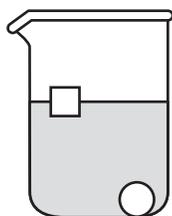
²Item Type: MC = Multiple Choice, CR = Constructed Response, SA = Short Answer

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

PS1 (9-11) INQ-1 Students will use physical and chemical properties as determined through an investigation to identify a substance.

- 1 A student drops two plastic beads with different densities into an alcohol solution. One bead has a density of 0.87 g/cm^3 , and the other bead has a density of 0.83 g/cm^3 . The picture below shows the positions of the beads in the solution.

**Bead Positions
in Solution**



Based on the positions of the beads, which range describes the density of the solution?

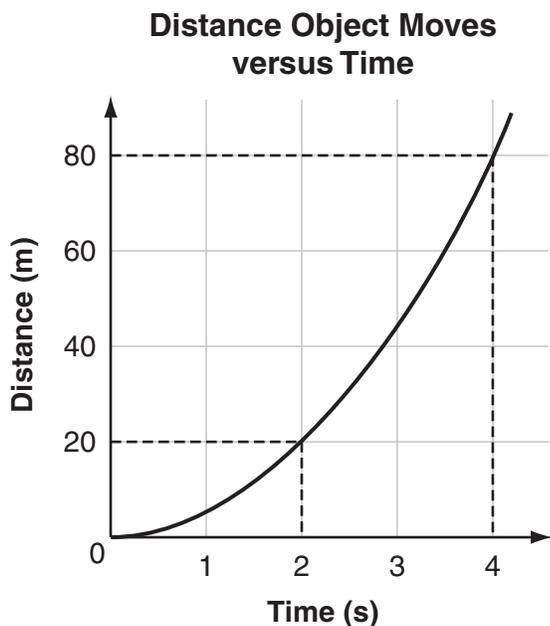
- A. $0.64\text{--}0.66 \text{ g/cm}^3$
 - B. $0.74\text{--}0.76 \text{ g/cm}^3$
 - C. $0.84\text{--}0.86 \text{ g/cm}^3$
 - D. $0.94\text{--}0.96 \text{ g/cm}^3$
- 2 Which data would **best** indicate that an exothermic reaction occurred in a solution?
- A. Gas bubbles formed.
 - B. Color changed from clear to blue.
 - C. Temperature decreased by 5°C .
 - D. Temperature increased by 6°C .

PS2 (9-11) SAE-6 Students will, using information provided about chemical changes, draw conclusions about and explain the energy flow in a given chemical reaction (e.g., exothermic reactions, endothermic reactions).

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GRADE 11 SCIENCE

PS3 (9-11) INQ-8 Students will, given information (e.g., graphs, data diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects.

- 3 The graph below shows the distance an object moves over time.



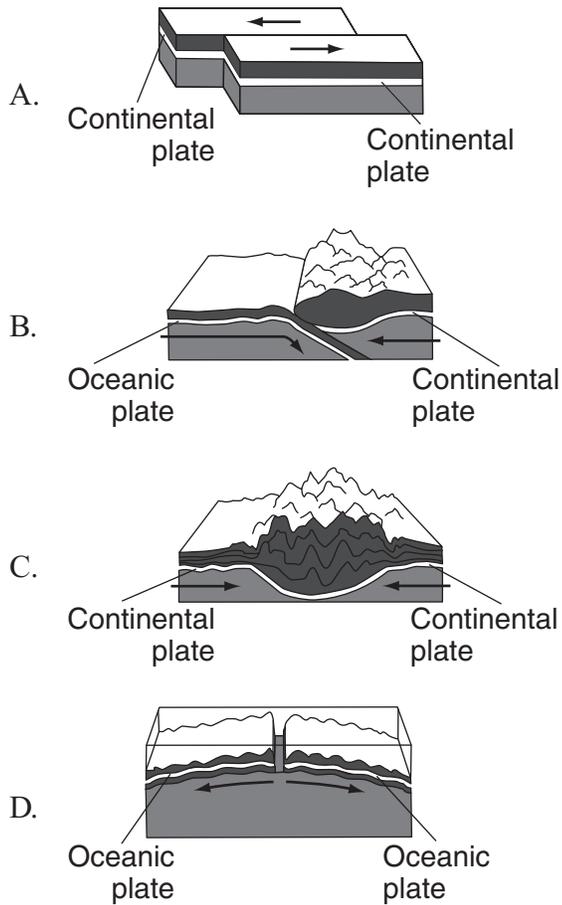
Which statement **best** describes the motion of the object?

- A. The object is traveling at a constant speed.
- B. The object is traveling with no net force.
- C. The object is accelerating.
- D. The object is changing directions.

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GRADE 11 SCIENCE

ESS1 (9-11) POC-1 Students will, provided with geologic data (including movement of plates) on a given locale, predict the likelihood for an Earth event (e.g., volcanoes, mountain ranges, islands, Earthquakes, tides, tsunamis).

4 Which model represents volcanoes forming by subduction?



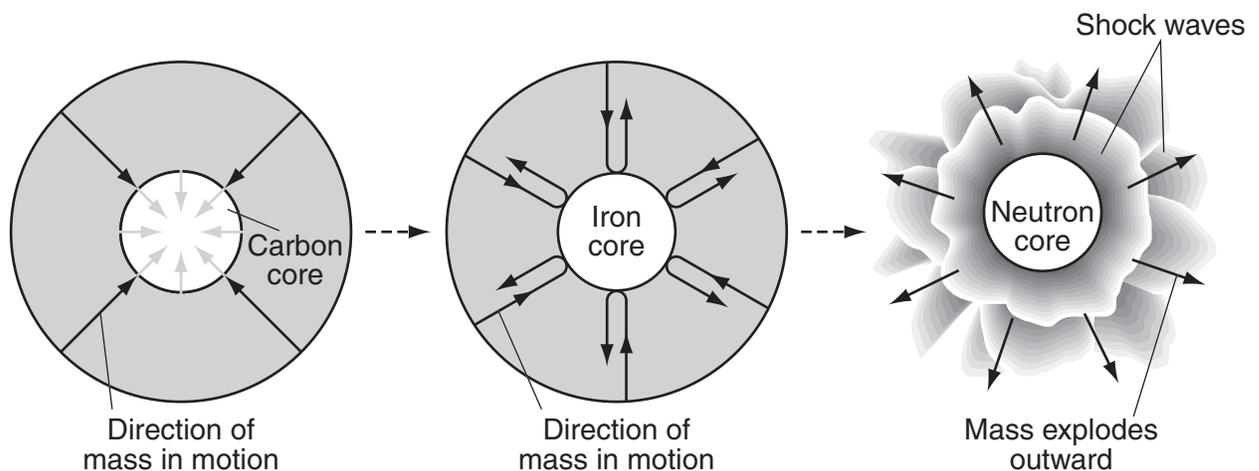
NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

ESS1 (9–11) POC-3 Students will explain how internal and external sources of heat (energy) fuel geologic processes (e.g., rock cycle, plate tectonics, sea floor spreading).

- 5 Why do many mountains have cores made of metamorphic rocks?
- A. Metamorphic rocks are the only rocks that form underground.
 - B. Metamorphic rocks are the only rocks found in mountains.
 - C. Metamorphic rocks are pushed down from Earth's surface when plates collide.
 - D. Metamorphic rocks are formed by heat and pressure when mountains form.

ESS3 (9-11) SAE-8 Students will explain the relationships between or among the energy produced from nuclear reactions, the origin of elements, and the life cycles of stars.

- 6 The diagram below shows a star becoming a supernova.



Which statement **best** explains why the star explodes?

- A. The mass of the star increases.
- B. The mass strikes the hard core and moves outward.
- C. The star interacts with a large nearby star.
- D. The star changes direction as it moves.

**NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE**

ESS1 (9-11) POC-1 Students will, provided with geologic data (including movement of plates) on a given locale, predict the likelihood for an Earth event (e.g., volcanoes, mountain ranges, islands, Earthquakes, tides, tsunamis).

Please use the Plate Movements diagram on the reference sheet to answer the question.

- 7** The table below lists some of Earth's specific plate boundary locations.

Earth's Plate Boundaries
South American Plate and African Plate
Nazca Plate and South American Plate
Caribbean Plate and North American Plate
African Plate and Eurasian Plate

- a. Select **two** plate boundaries listed in the table **and** describe in detail the expected motion of the plates in **each** location.
- b. For **each** boundary you selected in part (a), identify and describe **one** geologic feature that has formed there as a result of plate interactions.

**NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE**

Scoring Guide

Score	Description
4	Response demonstrates a thorough understanding of how geologic data regarding tectonic plates at a given locale can be used to predict specific constructive or destructive earth events. Response should include the specific geographic locations, describe the named plate interactions, and describe two expected geologic features and their locations.
3	Response demonstrates a general understanding of how geologic data regarding tectonic plates at a given locale can be used to predict specific constructive or destructive earth events. Response is general.
2	Response demonstrates a limited understanding of how geologic data regarding tectonic plates at a given locale can be used to predict specific constructive or destructive earth events. Response is limited.
1	Response demonstrates a minimal understanding of how geologic data regarding tectonic plates at a given locale can be used to predict specific constructive or destructive earth events. Response is minimal.
0	Response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Special Information:

Level	Description
Thorough	Description of the motion of <u>two</u> different plate boundaries from table and <u>two</u> geologic features caused by each boundary motion.
General	Description of how <u>two</u> plate boundaries are moving and <u>one</u> geologic feature caused by plate motions. Or Description of <u>one</u> plate boundary's motion and <u>two</u> geologic features caused by plate movement. Or All four parts (<u>two</u> boundaries and <u>two</u> features) generally explained.
Limited	Only <u>one</u> plate motion from part (a) and <u>one</u> feature in part (b) are correct. Or All of part (a) is correct and none of part (b); or all of part (b) is correct and none of part (a).
Minimal	Describe motion of <u>one</u> plate boundary; or <u>one</u> geologic feature.

**NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE**

Sample Responses for thorough understanding:

Location	Plate motion	Geologic feature or event
South American Plate and African Plate	The diverging oceanic plates are spreading apart.	<ul style="list-style-type: none"> • This interaction has formed the Mid-Atlantic Ridge—a long chain of underwater mountains • volcano • earthquakes • ocean crust made • rift or rift valley
Nazca Plate and the South American Plate	The denser oceanic plate will dive beneath the continental plate.	<ul style="list-style-type: none"> • Interaction forms an ocean trench. • Displaced continental rock is forced upward, forming mountains (Andes). • A region of volcanic activity occurs along boundary. • earthquakes
Caribbean Plate and North American Plate	The two plates in a transformation zone slide past each other in opposite directions. Convergent	<ul style="list-style-type: none"> • This interaction results in an earthquake event when buildup pressure/energy is released when the plates suddenly slip. • trench • volcanoes • islands
African Plate and Eurasian Plate	Converging continental plates slowly collide into each other. Transform boundary	<ul style="list-style-type: none"> • This plate interaction results in overthrusting, as one plate rides on top of the other plate—a major mountain building event (Alps). • volcanoes • earthquakes

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

SCORE POINT 4

7

b) The African plate and Eurasian Plate are convergent. This means that they are being forced together. As a result one plate will subduct under the other and push the other up possibly forming volcanoes or both plates will be pushed up forming a large mountain range.

The South American plate and the African Plate are divergent plates meaning they will separate. This will create new oceanic crust in the mid ocean ridge. The lava rises between the divergent plates doing this.

Each boundary fully discussed in turn (rather than as parts a and b) to include motion and a geologic feature.

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

SCORE POINT 3

7

a) The South American Plate and African Plate are moving away from each other. This gives even more reason that they could have been together.

The Nazca Plate and South American Plate are moving towards each other.

b) In the first one, the plate movement has made two separate continents.

In the second one, islands form because of the plate shifts.

Movements are correct as described in part a. The first geologic feature in part b is correct but island formation is incorrect.

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

SCORE POINT 2 (EXAMPLE A)

7

- (a) The Nazca Plate and the South American plate are going to collide and the African plate and Eurasian plates are moving away from each other
- (b) Mountains from the colliding plates and transform boundaries from the plates moving away from each other.

The motion of the African and Eurasian plates described in part a is incorrect. Only one geologic feature is provided in part b. The description is limited and lacks specific details.

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

SCORE POINT 2 (EXAMPLE B)

7 South American Plate and the African Plate are moving apart from each other.

Nazca Plate and the South American Plate seem to be colliding with each other.

Answers part a only; does not discuss the features that result from the plate movements.

SCORE POINT 1

7 A) South American plate and African plate moves away from each other.
B) Divergent boundary has formed

In part a, there is only one boundary and its motion. In part b, the boundary itself is not a geological feature.

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

SCORE POINT 0

7
a.) South American Plate and African Plate
Caribbean Plate and North American Plate

*

b.) One geologic feature of South American Plate is its known for there forests. Now the Caribbean Plate is known for its crystal blue great vacationed water.

In part a, two boundaries are named but their movement is not described. Part b is incorrect.

**NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE**

LS1 (9-11) POC-2 Students will explain or justify with evidence how the alteration of the DNA sequence may produce new gene combinations that make little difference, enhance capabilities, or can be harmful to the organism (e.g., selective breeding, genetic engineering, mutations).

Please use the genetic code on the reference sheet to answer the question.

- 8 Crohn's disease has been linked to a defect in a gene. The diagrams below compare part of the DNA encoding the normal gene with part of the DNA encoding the defective gene. In the defective gene, a cytosine (C) is inserted, as shown by the arrow below.

Normal gene

AGC|CCT|CCT|GCA|GGC|CCT|TGA|AAG|GAA

Defective gene

AGC|CCT|CCT|GCA|GGC|CCC|TTG|AAA|GGA



Based on the diagrams, what is the result of the mutation?

- A. The wrong amino acid is added at the start of the protein.
- B. A stop codon shortens the protein.
- C. The amino acid sequence is altered in the remainder of the protein.
- D. The protein is produced without any change in sequence.

**NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE**

LS3 (9-11) INQ-6 Students will explain how evidence from technological advances supports or refutes the genetic relationships among groups of organisms (e.g., DNA analysis, protein analysis).

- 9 The diagram below shows the partial DNA fingerprints of two parents and their three children.

F	M	Children		
1	2	3	4	5
—	—		—	—
—		—		
	—	—		—

Key	
F	represents the father
M	represents the mother

What is the **most likely** reason the mother's DNA differs from her children's DNA?

- A. The children received all of their chromosomes from their father.
- B. The children received chromosomes from a great grandparent.
- C. The children received half their chromosomes from each parent.
- D. The children received more chromosomes from their father than from their mother.

NECAP 2013 RELEASED ITEMS
GRADE 11 SCIENCE

LS3 (9-11) FAF-8 Students will, given information about living or extinct organisms, cite evidence to explain the frequency of inherited characteristics of organisms in a population, OR explain the evolution of varied structures (with defined functions) that affected the organisms' survival in a specific environment (e.g., giraffe, wind pollination of flowers).

- 10 The pictures below show an ocotillo plant from southwestern North America and an alluaudia plant from Madagascar. These plants have no common ancestors. Their resemblance is caused by adaptations in response to similar environments.



Ocotillo plant



Alluaudia plant

Which process **most likely** caused these plants to produce similar structures?

- A. convergent evolution
- B. divergent evolution
- C. genetic mutation
- D. genetic recombination

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 12:	Developing and Evaluating Explanations Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis
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- ① Explain how one piece of information given in the story could be used to determine how the life cycle of our sun compares to the life cycle of other stars.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of evidence supporting a conclusion. The response describes the data that supports how the life cycle of the Sun compares to the life cycle of other stars.
1	The response demonstrates a limited understanding of evidence supporting a conclusion.
0	Response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Possible responses include:

- The Sun's mass is between 0.1 to 3.0 solar masses so will become a red giant.
- The Sun fuses hydrogen and will enlarge.

Some statements are not inferences and do not support evidence in the scenario. These do not receive credit.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 2

- ① One piece of information that could be used to compare the lifecycle of our sun to other stars is its mass. According to research done by Jay Kim, the greater the stars mass, the greater its luminosity and the shorter its life as a main sequence star. By comparing the masses of stars, the length of their life cycles could be determined.

The response correctly uses mass to compare the life cycles of the stars.

SCORE POINT 1

- ① One piece of information that determines the life cycle of the sun is its size. The larger the star the faster it burns out.

A comparison is implied [size]. The response lacks the context of life cycle.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 0

1 the star is older
then our sun & much
bigger.

Incorrect. The response does not relate to life cycle.

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 11:	Developing and Evaluating Explanations Analyze data, including determining if data are relevant, artifact, irrelevant, or anomalous
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- 2 Based on Diagram 1 and the information Kim and Jay have found thus far in the story, describe additional information that can be inferred when comparing other stars to the Sun. Cite evidence to support your answer.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of analyzing data, including determining if data are relevant, artifact, irrelevant, or anomalous. The response includes a general description of the inferences when comparing other stars to the Sun with evidence as support.
1	The response demonstrates a limited understanding of analyzing data, including determining if data are relevant, artifact, irrelevant, or anomalous.
0	Response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Possible responses include:

- Stars have a wide range of luminosity (bright, dim) and temperatures compared to the Sun.
- Stars dimmer than the Sun can be hotter or cooler than the Sun.

Note: Stars can have the same surface temperature independent of their luminosity.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 2

2 Because L_{\odot} is exponentially related to mass, stars that are larger than our sun are brighter and stars that are smaller are dimmer. Our sun has a surface temperature of 10,000 K, which is in the middle of the other stars depicted. The sun is also in the middle of the L_{\odot} scale. The ratio of surface temperature to L_{\odot} of our sun is much more even than the other stars Kim and Jay's finding on their research question shows that stars with a higher L_{\odot} will have less time in the main sequence compared to our sun. Those with a lower L_{\odot} will stay in the main sequence for much longer.

The response effectively integrates information from the diagram and from the story to compare other stars to the Sun.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 1

2 The diagram shows the Sun at a stable, middle-point of the graph, whereas all the other stars have properties more extreme. The Sun is not too hot or too cool, nor is it too bright or too dim.

A correct comparison is made based on the diagram, however the language used in the response is less specific.

SCORE POINT 0

2 Two stars are not just like the Sun.

The response is too vague to indicate understanding.

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 2:	Formulating Questions & Hypothesizing Construct coherent argument in support of a question, hypothesis, prediction.
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- 3 Describe the characteristics that affect the life cycle of stars that are less massive than the Sun **and** stars that are more massive than the Sun. Use evidence from Diagram 2 to support your answer.

Scoring Guide

Score	Description
3	The response demonstrates a thorough understanding of constructing coherent arguments in support of a question, hypothesis, or prediction. The response describes the characteristics of stars that are more massive and less massive than the Sun and includes support from the diagram.
2	The response demonstrates a general understanding of constructing coherent arguments in support of a question, hypothesis, or prediction.
1	The response demonstrates a limited understanding of constructing coherent arguments in support of a question, hypothesis, or prediction.
0	Response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Possible student responses include:

- Hotter and brighter stars are more massive than the Sun.
- Brighter and cooler stars that are not in the main sequence may be more massive than the Sun.
- Many of the less bright and cooler stars are less massive than the Sun.

Responses include evidence that supports the above statements.

SCORE POINT 3

3 The characteristics that affect the life cycle of stars that are less massive than the Sun is that they have lower luminosities and, in many cases, lower surface temperatures, therefore having a longer life span than those that are more massive than the Sun. The life cycle of stars that are less massive than the Sun are longer (lives in the main-sequence) which is estimated about 90% of their lives as stated on page 31, and they burn nuclear material more slowly.

The characteristics that affect the life cycle of stars that are more massive than the Sun is they have higher luminosity, therefore shorter life spans, and they burn nuclear material more quickly and are more likely to cause fusion of different elements to occur simultaneously due to the higher surface temperatures they acquire, as shown in Diagram 2.

The response thoroughly describes the characteristics of stars more massive and less massive than the Sun. The response refers to information from both the diagram and the story, and discusses the life cycle as it is affected by the burning of nuclear material.

SCORE POINT 2

- ③ When a star has a much higher mass, its temperature is much higher, and therefore has a greater luminosity, which causes the star to go through its life quicker. When a star has a lower mass, its temperature and luminosity is lower, and the star generally has a longer lifespan.

The descriptions in this response include more generalities and fewer details. No specific evidence to support the response is cited.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 1

3
Stars that are less massive than the sun have lower luminosity and temperature.

Stars that are more massive than the sun have a higher luminosity and temperature.

The response is an interpretation of the H-R diagram. It does not discuss the differences in the stars' life cycles. Minimal credit.

SCORE POINT 0

3
The stars that are less
massive have much
shorter life spans
because they're
hydrogen is limited,
once they run out.
They die.

Incorrect interpretation of the diagram.

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 1:	Formulating Questions & Hypothesizing Analyze information from observations, research, or experimental data for the purpose of formulating a question, hypothesis, or prediction.
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- 4 Based on Diagram 2, predict the luminosity (L_{\odot}) and temperature (K) of a star with a solar mass of $100 M_{\text{Sun}}$. Use evidence from Diagram 2 and information from the story to support your answer.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of analyzing information from observations, research, or experimental data for the purpose of formulating a prediction. The response predicts the luminosity of a star with $100 M_{\text{Sun}}$ and supports prediction with evidence.
1	The response demonstrates a limited understanding of analyzing information from observations, research, or experimental data for the purpose of formulating a prediction.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

The star would have a much higher luminosity and temperature than the $100 M_{\text{Sun}}$ star (which is the highest on the graph).

Note: must include reasoning to support the answer.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 2

4 A star with a solar mass of $100M_{\text{sun}}$ would have a very high luminosity rating, probably greater than 10^6 and the surface temperature would be very high as well, probably greater than $50,000\text{K}$. This can be assumed from diagram 2 because it shows large increases for masses greater than the sun.

The response includes a correct interpretation of the data and a correct estimate of increased luminosity and temperature.

SCORE POINT 1 (EXAMPLE A)

4
Temp = $150,000\text{K}$
Luminosity = 10^{10}

A valid prediction of both temperature and luminosity but with no supporting evidence.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 1 (EXAMPLE B)

4 If a star has the solar mass of $100 M_{\text{sun}}$, then it will have extremely high luminosity, because it will be much bigger. Also, a lot of fusion will occur.

The response predicts luminosity based on its bigger size, but does not include a prediction of temperature.

SCORE POINT 0

4 My Prediction of the luminosity (L_{\odot}) and temperature (K) of a star with a solar mass $100 M_{\text{sun}}$ is that the star is a fairly bright star. It is at about half way on the scale which means it's right by the sun.

Incorrect.

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 8:	Conducting Investigations Use accepted methods for organizing, representing, and manipulating data.
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- 5 On the grid provided, construct a scatter plot of the stars included in Data Table 1. Be sure to correctly label and title your scatter plot and identify (label) the stars.

Scoring Guide

Score	Description
3	The response demonstrates a thorough understanding of how to accurately represent data in a graph. The response includes a scatter plot of the data that has an appropriate title.
2	The response demonstrates a general understanding of how to accurately represent data in a graph.
1	The response demonstrates a limited understanding of how to accurately represent data in a graph.
0	Response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

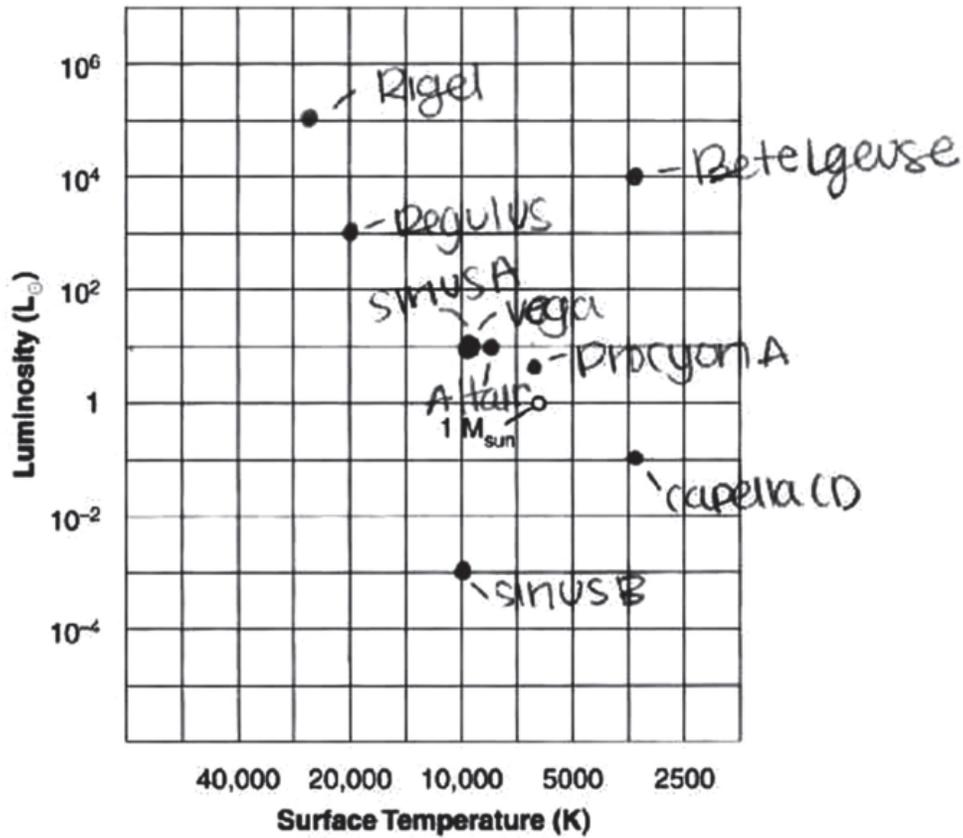
- Title: Luminosity (L_{\odot}) vs. Temperature (K)
- All stars need to be labeled.
- All stars need to be accurately plotted for a 3-point score.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 3

5

Luminosity v. surface temp. of stars

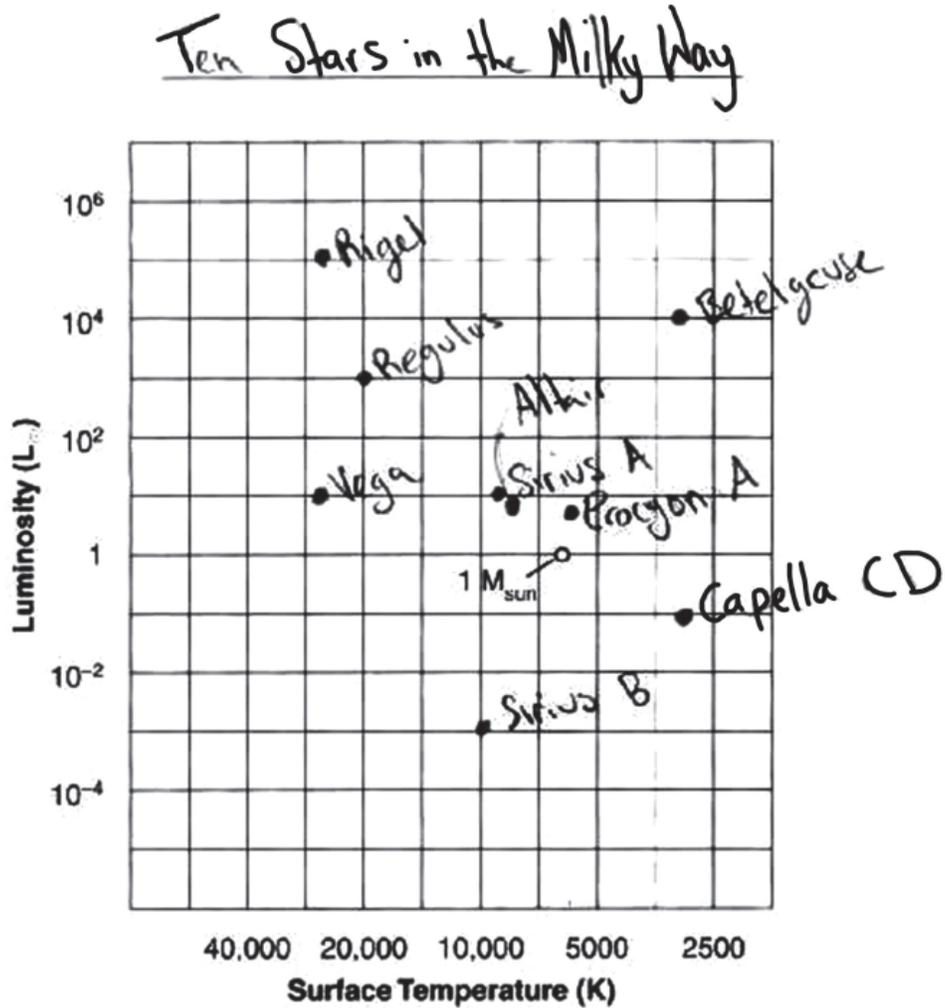


Accurate and complete graph. All parts are correctly plotted and labeled. Title is correct.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 2

5

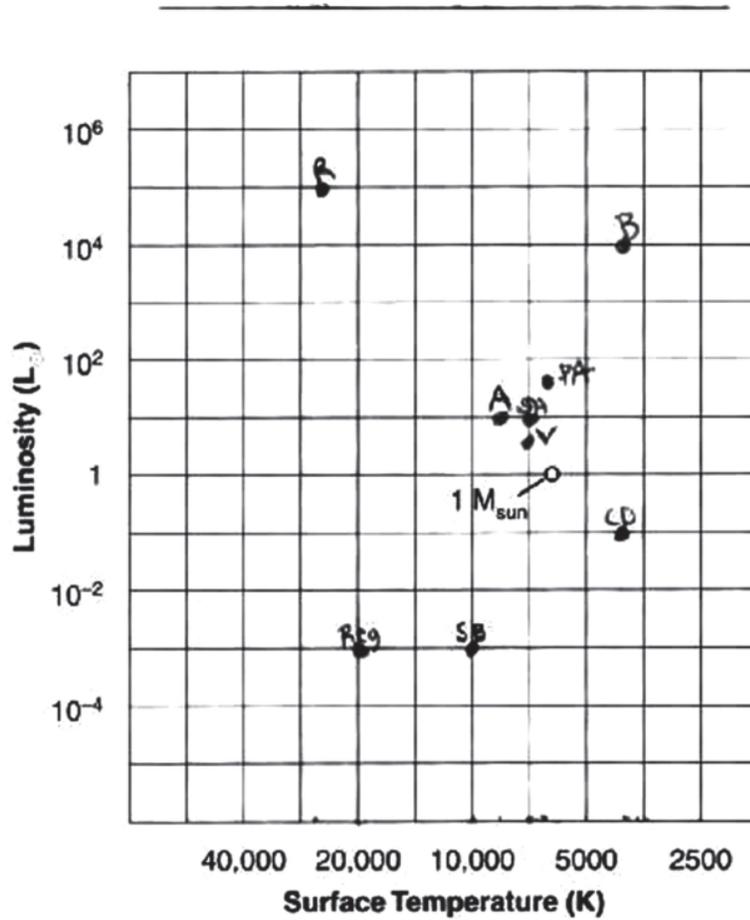


Response includes a vague title that does not accurately reflect the contents of the graph. Also, Vega is misplaced on the graph.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 1

5

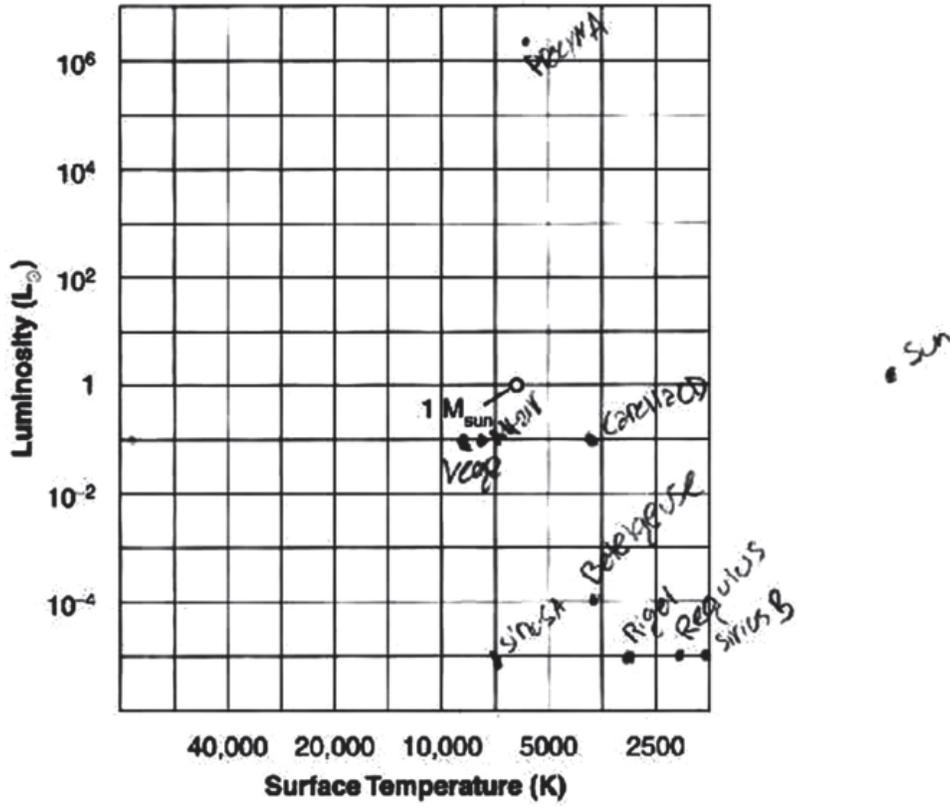


Response has multiple errors. No title is included. Regulus is misplaced on the graph. There are abbreviations rather than labels, but without a key this graph is less understandable.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 0

5



Cappela is the only star correctly graphed. No credit.

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 12:	Developing and Evaluating Expectations Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.
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- 6 Identify which stars in Data Table 1 or your scatter plot do **not** fit well with the pattern of the other stars in your scatter plot. Use your data to describe how these stars compare to the Sun.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis. The response identifies the stars outside the main sequence and describes how they compare to the Sun.
1	The response demonstrates a limited understanding of how to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Possible student responses for the star include:

- Betelgeuse
- Sirius B

Possible student responses for the comparison to the Sun: For Betelgeuse: The star is larger (mass) than the Sun. The star is cooler than the Sun. For Sirius B: The star is at the end of its life as a white dwarf. The star is smaller than the Sun.

NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE

SCORE POINT 2 (EXAMPLE A)

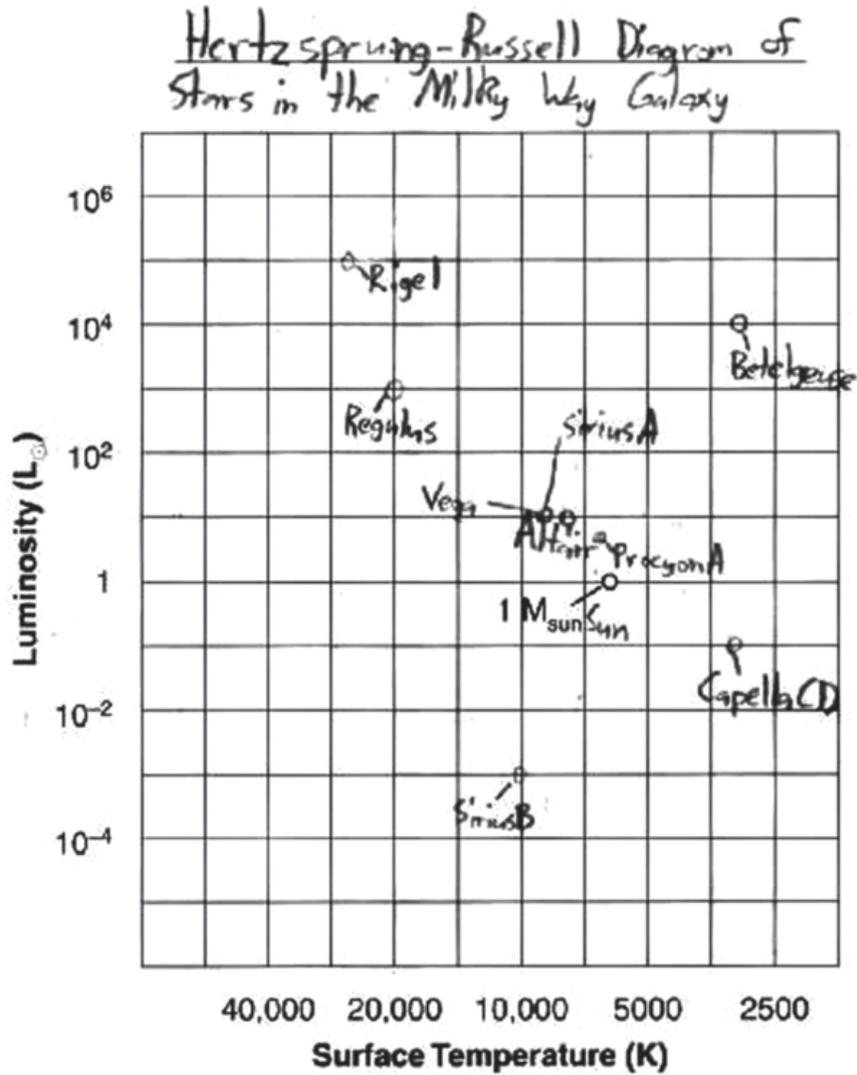
6

All except for two stars, Betelgeuse and Sirius B, fit perfectly into a pattern. The other eight lie on a pretty straight line with the Sun. The higher the surface temperature, the higher the luminosity. They range from Capella (D) ($10^1 L_{\odot}$, 3,200K), to Rigel ($10^5 L_{\odot}$, 28,000K). However Betelgeuse is colder than the Sun ($1 L_{\odot}$, 5,800K) with a temp. of 3,200 K, but has a higher luminosity ($10^4 L_{\odot}$). Another star that doesn't fit is Sirius B with a higher temp. than the Sun (10,000K), though a lower luminosity ($10^{-3} L_{\odot}$).

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SCORE POINT 2 (EXAMPLE A, CONTINUED)

5



Correct and complete analysis of the graph and the comparison of Betelgeuse and Sirius B to the Sun.

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SCORE POINT 2 (EXAMPLE B)

6

The Betelgeuse star does not fit in well with the pattern of the other stars. It has the same surface temperature as Capella CD and yet the luminosity is completely different ($10^{-1} < 10^4$).

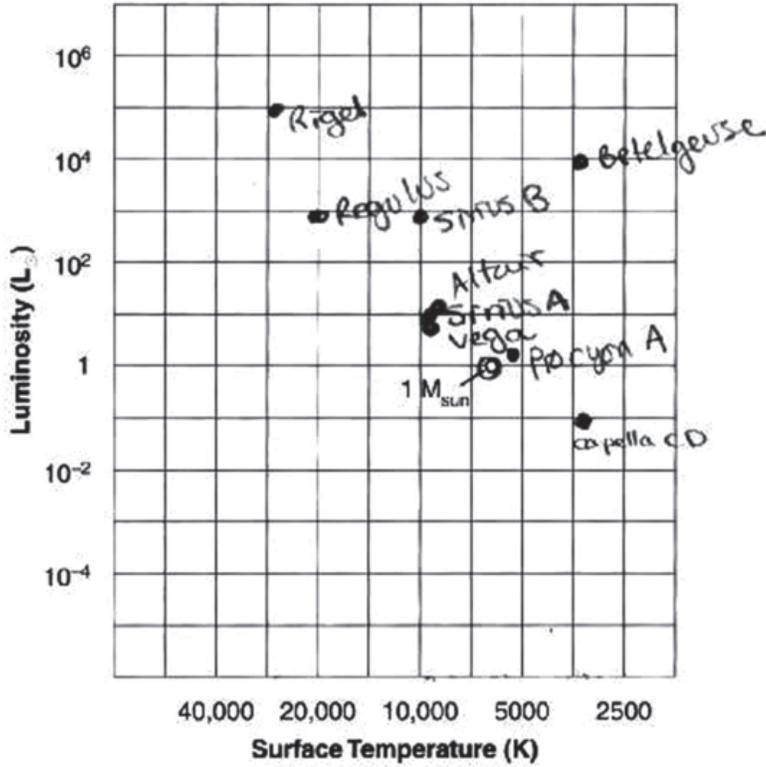
Compared to the sun, Betelgeuse has a lower temperature but a much higher luminosity. This does not fit with the trend of the rest of the graph.

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SCORE POINT 2 (EXAMPLE B, CONTINUED)

5

Comparison of Ten Stars in the Milky Way Galaxy



In the response for item #5, a graphing error resulted in only the outlier Betelgeuse being identified. The response in item #6 came to the correct conclusion based on the analysis of the graph that was plotted in item #5. The response correctly analyzes and compares Betelgeuse to the Sun, demonstrating general understanding.

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SCORE POINT 1

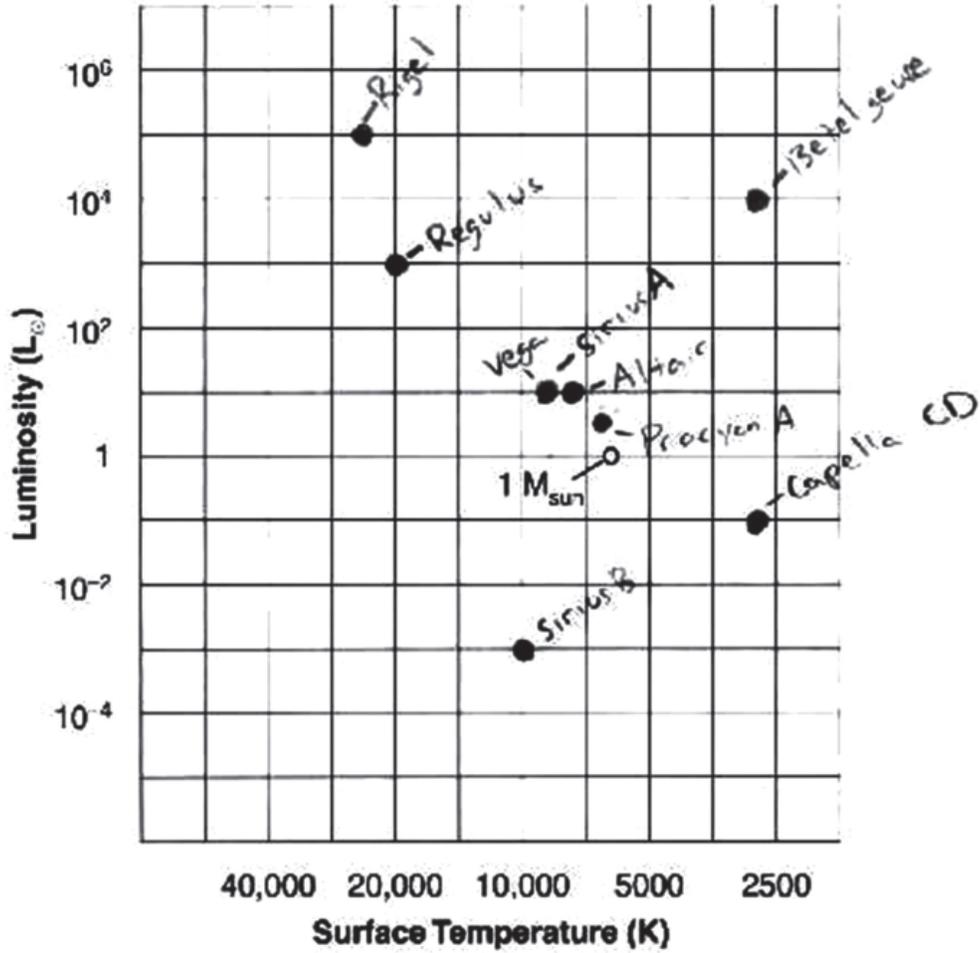
6
Two stars that are kind of outliers in the scatter plot are Sirius B and Betelgeuse since they do not follow the main flow or direction of the other points or stars.

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SCORE POINT 1 (CONTINUED)

5

Ten Stars in the Milky Way Galaxy



The two outliers (Sirius B and Betelgeuse) are correctly identified, but there is no comparison to the Sun.

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SCORE POINT 0

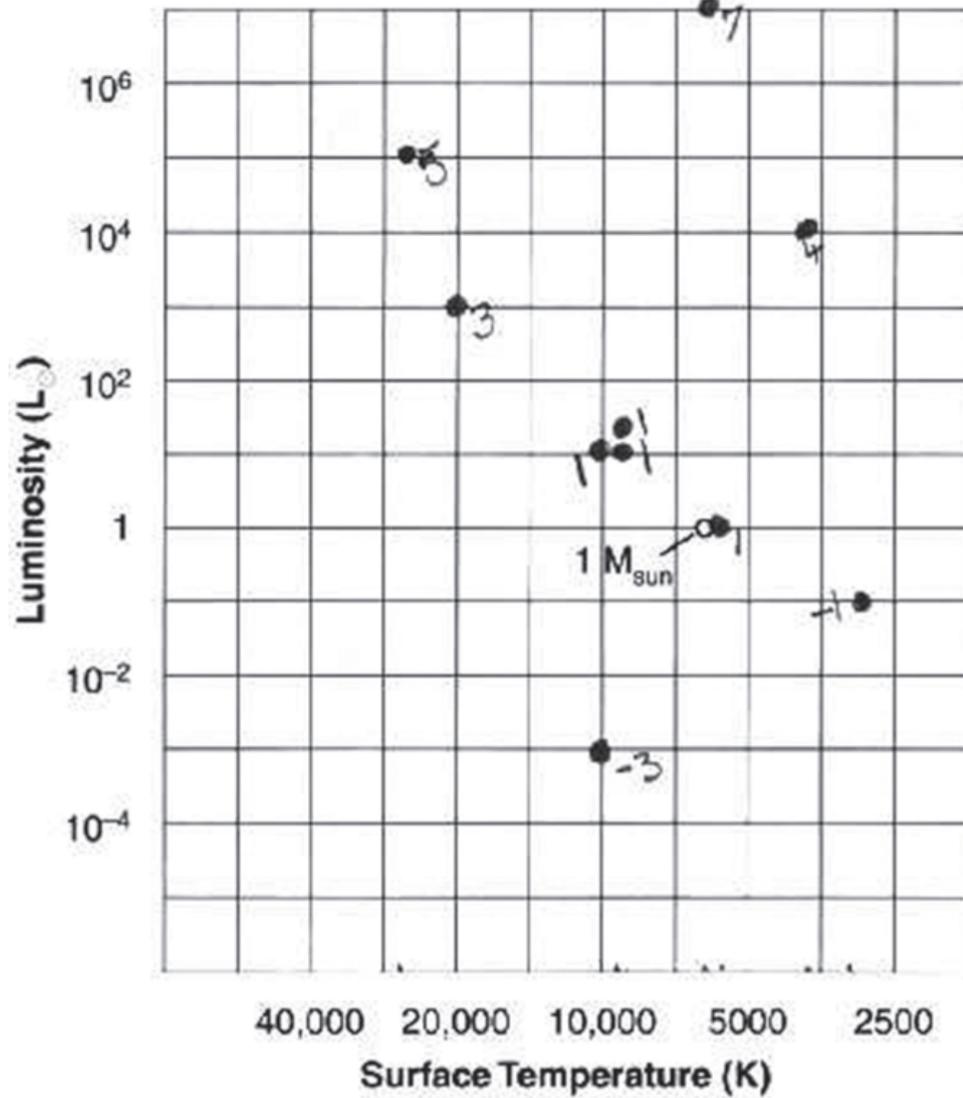
6

They scattered about randomly
and the luminosity and
temperatures are all over the
place.

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SCORE POINT 0 (CONTINUED)

5



Incorrect. Fails to see a pattern.

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Broad Area of Inquiry: Inquiry Construct 12:	Developing and Evaluating Expectations Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.
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- 7 Choose the prediction that most accurately represents the life cycle path the Sun will follow. Use information from the Life Cycle of a Star diagram to support your answer.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis. The response identifies the most accurate prediction and explains why.
1	The response demonstrates a limited understanding of how to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

Possible explanations include that Jay's prediction is most accurate:

- Based on the temperature and luminosity, the Sun will follow the average star path because the Sun has a solar mass of 1 and the temperature and luminosity of an average star.
- Based on its mass, the Sun doesn't have the characteristics to follow the massive star path because it isn't hot/luminous enough.

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GRADE 11 SCIENCE

SCORE POINT 2

7 Out of all the data, the Sun is pretty much in the middle, for example out of the stars chosen in Data Table 1 used in questions 5 & 6 the lowest temperature and luminosity were 3,200k and 10^{-3} and the highest were 28,000k and 10^5 . So, the sun, at 5,800k and luminosity of 1L0 is towards the lower side of the spectrum, so is not a massive star, but is a near-average star. Therefore the sun will most likely become a red giant, then a planetary nebula, then end its life as a white dwarf.

A correct prediction is made and arrived at logically. The response is solidly supported with information from previous tables and the diagram.

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SCORE POINT 1

7 My prediction is the same as Jay's. I think the Sun was an average star that exploded into a Red Giant that will eventually turn into a white dwarf.

A correct prediction is made with some supporting information from the diagram.

7

I think that the sun will become a red super giant after it leaves the main sequence because it is already the biggest star in the universe so it makes sense that it keeps getting bigger and doesn't just die down to a tiny white dwarf.

Incorrect.

**NECAP 2013 RELEASED INQUIRY TASK
GRADE 11 SCIENCE**

Broad Area of Inquiry: Inquiry Construct 12:	Developing and Evaluating Expectations Use evidence to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.
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8 Use information from Diagram 2 to support or refute the idea that the new star is a main-sequence star.

Scoring Guide

Score	Description
2	The response demonstrates a general understanding of how to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis. The response identifies the most accurate prediction and explains why.
1	The response demonstrates a limited understanding of how to support and justify interpretations and conclusions or explain how the evidence refutes the hypothesis.
0	The response is incorrect or irrelevant to the skill or concept being measured.
Blank	No response

Training Notes:

The star is not main sequence because its temperature and luminosity are off the main sequence line, which means it has a much higher mass than the Sun.

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SCORE POINT 2

8
Jay's belief that the star is a main sequence star is wrong. In diagram 2, a star with $10M_{\text{sun}}$ has a temperature of roughly $25,000\text{K}$ and a luminosity of just over 10^3 . An average main sequence star has a mass of $0.1M_{\text{sun}}$ to $10M_{\text{sun}}$. The new star is more than double the luminosity and twice the temperature of the $10M_{\text{sun}}$ star on diagram 2. Following trend lines and the fact that the mass is exponential, it is highly unlikely the new star is a main-sequence star.

The response is correct, with valid support, though the response does not directly relate the extreme temperature and luminosity to a high mass.

SCORE POINT 1

8
It is not a main sequence star because if it was it would be close to the other stars in the scatter plot but it is not.

The response is a vague reference to the star being an outlier.

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SCORE POINT 0

8

The new star is a main sequence star because the usually range from 1 M_{Sun} to 10 M_{Sun} and that star falls under that category

Incorrect. The new star will be larger than 10 M_{Sun} .