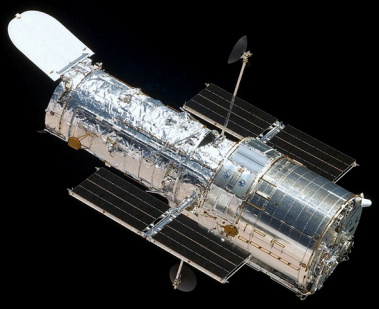
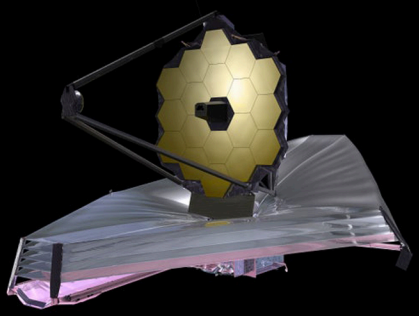
National Aeronautics and Space Administration





star party

NGSS High School Alignment Document

Star Party

High School Next Generation Science Standards Alignment Document

WHAT STUDENTS DO: Use a model to resolve questions and debate.

Students use a model to create stars from a stellar nebula and track those stars through their life cycles in an attempt to resolve conflicts and answer questions from party attendees. They will collect evidence of star colors, luminosity, solar mass, lifespans, composition, and temperature along their journey.

NRC FRAMEWORK/NGSS CORE & COMPONENT QUESTIONS	INSTRUCTIONAL OBJECTIVES (IO)
WHAT IS THE UNIVERSE, AND WHAT IS EARTH'S PLACE IN IT? *NGSS Core Question: ESS1: Earth's Place in the Universe* **What is the universe, and what goes on in stars?** *NGSS ESS1.A: The Universe and Its Stars*	*Students will be able to* **IO1: Compare competing arguments related to the life cycle of stars and evaluate empirical evidence collected as a scientific way of knowing.**

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1.0 About This Activity

How Students Learn: Science in the Classroom (Donovan & Bransford, 2005) advocates the use of a research-based instructional model for improving students' grasp of central science concepts. Based on conceptual-change theory in science education, the 5E Instructional Model (BSCS, 2006) includes five steps for teaching and learning: Engage, Explore, Explain, Elaborate, and Evaluate. The Engage stage is used like a traditional warm-up to pique student curiosity, interest, and other motivation-related behaviors and to assess students' prior knowledge. The Explore step allows students to deepen their understanding and challenges existing preconceptions and misconceptions, offering alternative explanations that help them form new schemata. In Explain, students communicate what they have learned, illustrating initial conceptual change. The Elaborate phase gives students the opportunity to apply their newfound knowledge to novel situations and supports the reinforcement of new schemata or its transfer. Finally, the Evaluate stage serves as a time for students' own formative assessment, as well as for educators' diagnosis of areas of confusion and differentiation of further instruction. The 5E stages can be cyclical and iterative.

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2.0 Instructional Objectives, Learning Outcomes, Standards, & Rubrics

Visit https://infiniscope.org/lesson/star-party/ for access to the digital learning experience, lesson plans, standards alignment documents, and additional resources.

Instructional objectives and learning outcomes are aligned with

- Achieve Inc.'s, *Next Generation Science Standards (NGSS)*
- National Research Council's, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*
- National Governors Association Center for Best Practices (NGA Center) and Council of Chief State School Officers (CCSSO)'s, *Common Core State Standards for Mathematics*
- Partnership for 21st Century Skills, *A Framework for 21st Century Learning*

The following chart provides details on alignment among the core and component NGSS questions, instructional objectives, learning outcomes, and educational standards.

- Your **instructional objectives (IO)** for this lesson align with the NRC Framework and NGSS.
- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO),** also aligned with the NRC Framework and NGSS.
- You will know the level to which your students have achieved the learning outcomes by using the suggested **rubrics**.

Important Note: This lesson is color-coded to help teachers identify each of the three dimensions of NGSS. The following identifying colors are used: Practices are blue, Cross-Cutting Concepts are green, and Disciplinary Core Ideas are orange.

This color-coding is consistent with the NGSS Performance Expectations and Foundation Boxes.

Quick View of Standards Alignment:

This alignment document provides full details of the way in which instructional objectives, learning outcomes, 5E activity procedures, and rubric assessments were derived through, and align with the Next Generation Science Standards (NGSS). For convenience, a quick view follows:

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WHAT IS THE UNIVERSE, AND WHAT IS EARTH'S PLACE IN IT?

NGSS Core Question: ESS1: Earth's Place in the Universe

What is the universe, and what goes on in stars?

NGSS ESS1.A: The Universe and Its Stars

Instructional Objective *Students will be able to*	**Learning Outcomes** *Students will demonstrate the measurable abilities*	**Standards** *Students will address*
IO1: **Compare competing arguments related to the life cycle of stars and evaluate empirical evidence collected as a scientific way of knowing.**	**LO1a: Generate procedures to effectively use a stellar life cycle model in order to collect empirical evidence.** **LO1b: Use the HR diagram to model and explain the relationships between stellar mass and the star's luminosity and temperature.** **LO1c: Use a model to support or refute a claim about the relationships between the mass of a star (such as the Sun), it's color, and the lifetime of that star.** **LO1d: Model and explain the life cycle of a star and its relationship to the origin and process of element formation in a solar system.** **LO1e: Explain the purpose, benefits, and limitations of the model in describing the sun's life cycle.**	**PRACTICES:** **1. Developing and Using Models** **2. Planning and Carrying Out Investigations** **3. Analyzing and Interpreting Data** **4. Using Mathematics and Computational Thinking** **5. Constructing Explanations and Designing Solutions** **6. Engaging in Argument from Evidence** **DISCIPLINARY CORE IDEAS:** **ESS1.A: The Universe and its Stars** **CROSSCUTTING CONCEPTS:** **1. Patterns** **2. Scale, Proportion, and Quantity** **3. Cause and Effect** **4. System and Systems Models** **Science is a Way of Knowing**

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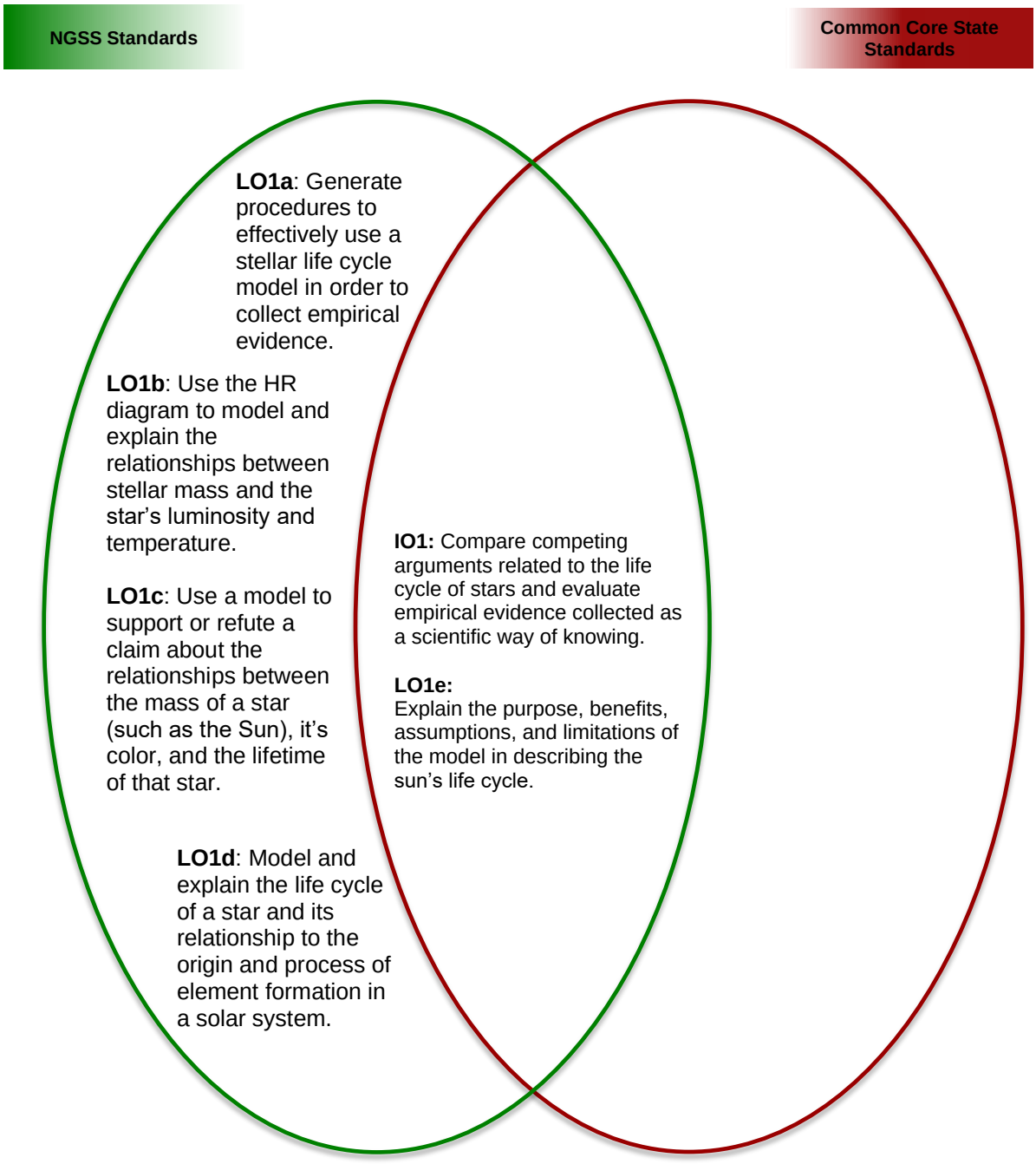
3.0 Instructional Objective, NGSS, Common Core, & 21st Century Skills Connections

The connections diagram is used to organize the instructional objective addressed in the lesson to establish where it will meet the Next Generation Science Standards, Common Core Standards, and the 21st Century Skills and visually determine where there are overlaps in these documents. See Common Core Alignment Document and 21st Century Skills Alignment Document for details on their specific alignments.



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4.0 Evaluation/Assessment

Use the *(N) Star Party Alignment Rubric* as a formative and summative assessment, allowing students to improve their work and learn from mistakes during class. The rubric evaluates the activities using the Next Generation Science Standards (NGSS).

5.0 References

Achieve, Inc. (2013). *Next generation science standards*. Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS.

Bybee, R., Taylor, J., Gardner, A., Van Scotter, P., Carson Powell, J., Westbrook, A., Landes, N. (2006) *The BSCS 5E instructional model: origins, effectiveness, and applications.* Colorado Springs: BSCS.

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National Academies Press. (1996, January 1). *National science education standards*. Retrieved February 7, 2011 from http://www.nap.edu/catalog.php?record_id=4962

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The Partnership for 21st Century Skills (2011). *A framework for 21st century learning.* Retrieved March 15, 2012 from http://www.p21.org

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(M) Teacher Resource. Star Party NGSS Alignment (1 of 3)

You will know the level to which your students have achieved the **Learning Outcomes**, and thus the **Instructional Objective(s)**, by using the suggested **Rubrics** below.

Related Standard(s)

This lesson supports the preparation of students toward achieving Performance Expectations using the Practices, Cross-Cutting Concepts and Disciplinary Core Ideas defined below: (HS-ESS1-4)

Next Generation Science Standards

Instructional Objective	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
IO1: **Compare competing arguments related to the life cycle of stars and evaluate empirical evidence collected as a scientific way of knowing.**	**Engaging in Argument from Evidence** Compare and evaluate competing arguments in light of currently accepted explanations, new evidence, limitations, constraints, and ethical issues. Construct, use, and/or present oral and written arguments or counter-arguments based on data and evidence.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	**Patterns** Empirical evidence is needed to identify patterns. **Science is a Way of Knowing** Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review.

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(M) Teacher Resource. Star Party NGSS Alignment (2 of 3)

Next Generation Science Standards

Learning Outcomes	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
LO1a: **Generate procedures to effectively use a stellar life cycle model in order to collect empirical evidence.**	**Planning and Carrying Out Investigations** Plan an investigation individually to produce data to serve as the basis for evidence supporting explanations for phenomena.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	**Patterns** Empirical evidence is needed to identify patterns.
LO1b: **Use the HR diagram to model and explain the relationships between stellar mass and the star's luminosity and temperature.**	**Developing and Using Models** Use a model (including mathematical and computational) to generate data to support explanations and predict phenomena. **Using Mathematics and Computational Thinking** Use computational representations of phenomena to describe and support claims and/or explanations.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light	**Patterns** Empirical evidence is needed to identify patterns. **Cause and effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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	Constructing Explanations and Designing Solutions Apply scientific ideas, principles, and evidence to provide an explanation of phenomena.	spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	
LO1c: **Use a model to support or refute a claim about the relationships between the mass of a star (such as the Sun), it's color, and the lifetime of that star.**	**Developing and Using Models** Use a model (including mathematical and computational) to generate data to support explanations and predict phenomena. **Analyzing and Interpreting Data** Analyze data using a model (e.g., computational, mathematical) in order to make valid and reliable scientific claims. **Constructing Explanations and Designing Solutions** Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. Apply scientific ideas, principles, and evidence to provide an explanation of phenomena. **Engaging in Argument from Evidence** Construct, use, and/or present a written argument or counter-argument based on data and evidence.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	**Patterns** Empirical evidence is needed to identify patterns. **Cause and effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

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LO1d: **Model and explain the life cycle of a star and its relationship to the origin and process of element formation in a solar system.**	**Developing and Using Models** Use a model (including mathematical and computational) to generate data to support explanations and predict phenomena. **Analyzing and Interpreting Data** Analyze data using a model (e.g., computational, mathematical) in order to make valid and reliable scientific claims. **Using Mathematics and Computational Thinking** Use computational representations of phenomena to describe and support claims and/or explanations. **Constructing Explanations and Designing Solutions** Apply scientific ideas, principles, and evidence to provide an explanation of phenomena.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	**Patterns** Empirical evidence is needed to identify patterns. **Cause and effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
LO1e: **Explain the purpose, benefits, and limitations of the model in describing the sun's life cycle.**	**Developing and Using Models** Use a model (including mathematical and computational) to generate data to support explanations and predict phenomena. **Using Mathematics and Computational Thinking** Use computational representations of phenomena to describe and support claims and/or explanations.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of	**Scale, Proportion, and Quantity** Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. **System and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions - including energy, matter, and

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	Constructing Explanations and Designing Solutions Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. Apply scientific ideas, principles, and evidence to provide an explanation of phenomena.	stars, their movements, and their distances from Earth.	information flows - within and between systems at different scales Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximation inherent in models.

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(M) Teacher Resource. Star Party NGSS Individual Activity Alignment (3 of 3)

Next Generation Science Standards Activity Alignments (NGSS)

Activity	Phases of 5E Instructional Model	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
Eyes on Exoplanets	**Engage**			
Star Party Exploratory Activity	**Explore / Explain**	**Developing and Using Models** Use a model (including mathematical and computational) to generate data to support explanations and predict phenomena. **Planning and Carrying Out Investigations** Plan an investigation individually to produce data to serve as the basis for evidence supporting explanations for phenomena. **Analyzing and Interpreting Data** Analyze data using a model (e.g., computational, mathematical) in order to make valid and reliable scientific claims. **Using Mathematics and Computational Thinking**	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	**Patterns** Empirical evidence is needed to identify patterns. **Cause and effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Scale, Proportion, and Quantity** Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

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		Use computational representations of phenomena to describe and support claims and/or explanations. **Constructing Explanations and Designing Solutions** Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. Apply scientific ideas, principles, and evidence to provide an explanation of phenomena. **Engaging in Argument from Evidence** Construct, use, and/or present a written argument or counter-argument based on data and evidence.		
(C) Considering Alternatives	**Elaborate**	**Constructing Explanations and Designing Solutions** Apply scientific ideas, principles, and evidence to provide an explanation of phenomena. **Engaging in Argument from Evidence** Construct, use, and/or present a written argument or counter-argument based on data and evidence.	**PS2.B: Types of Interactions** Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—for example, Earth and the sun. Long-range gravitational interactions govern the evolution and maintenance of large-scale systems in space, such as galaxies or the solar system, and determine the patterns of motion within those structures.	**Patterns** Empirical evidence is needed to identify patterns. **Cause and effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. **Science is a Way of Knowing** Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review.

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(D) Resolve the Star Party Conflict	**Evaluate**	**Engaging in Argument from Evidence** Compare and evaluate competing arguments in light of currently accepted explanations, new evidence, limitations, constraints, and ethical issues. Construct, use, and/or present oral and written arguments or counter-arguments based on data and evidence.	**ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a life span of approximately 10 billion years. The sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth.	**Patterns** Empirical evidence is needed to identify patterns. **Science is a Way of Knowing** Science distinguishes itself from other ways of knowing through use of empirical standards, logical arguments, and skeptical review.

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(N) Teacher Resource. Star Party NGSS Alignment Rubric

Related Rubrics for the Assessment of Learning Outcomes Associated with the Above Standard(s):

Next Generation Science Standards Alignment (NGSS)

Instructional Objective	Expert	Proficient	Intermediate	Beginner
IO1: Compare competing arguments related to the life cycle of stars and evaluate empirical evidence collected as a scientific way of knowing.	Fully articulates the differences between a personal way of knowing vs a scientific way of knowing and includes examples from the Star Party exploration to support these differences. The description of the star life cycle includes mass of the star, lifespan, color of stars, and differences in end stages based on the mass of the star.	Articulates the primary difference between a personal way of knowing vs a scientific way of knowing and includes examples from the Star Party exploration to support this difference. The description of the star life cycle includes mass of the star, lifespan, color of stars, and differences in end stages based on the mass of the star.	Articulates the primary difference between a personal way of knowing vs a scientific way of knowing. The description of the star life cycle includes some of the following: mass of the star, lifespan, color of stars, and differences in end stages based on the mass of the star.	Makes a claim that either Pete or Gene is correct. Description of the star life cycle focuses primarily on death stage of a star.

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1e: Explain the purpose, benefits, assumptions, and limitations of the model in describing the sun's life cycle.	***Fully*** describes the use of models to simulate and predict phenomena, including examples of the benefits, assumptions, ***and*** limitations from stellar life cycle simulation.	Describes the use of models to simulate and predict phenomena, including examples of the benefits, assumptions, ***and*** limitations from stellar life cycle simulation.	Describes the use of models to simulate and predict phenomena, including examples of the benefits, assumptions, ***or*** limitations from stellar life cycle simulation.	Explains this is a computer model that simulates star birth and death.

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