

kingdom in peril



Kingdom in Peril

Middle School NRC Framework for Science Education Alignment Document



WHAT STUDENTS DO: Explore the arrangement of Sun, Earth, and Earth's moon necessary to generate eclipses.

Students will assume the role of a 17th century monarch who must learn and understand eclipse phenomena to save the kingdom from revolt. Students will explore the arrangement of the Sun, Earth, Moon system, and inclination of the Moon's orbit necessary to generate solar and lunar eclipse patterns experienced on Earth. They will explore the shadow zones and likelihood of observing these phenomena.

NRC FRAMEWORK/NGSS CORE & COMPONENT QUESTIONS

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

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

What are the predictable patterns caused by Earth's movement in the solar system?

ESS1.B: Earth and the Solar System

INSTRUCTIONAL OBJECTIVES (IO)

Students will be able to

IO1: Explain predictable eclipse patterns using a model to discover and demonstrate the evidence of phenomena at different scales such as the Moon's inclination (orbital plane) in combination with the position of the Sun, Earth, Moon system.

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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.



2.0 Instructional Objectives, Learning Outcomes, Standards, & Rubrics

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

Instructional objectives and learning outcomes are aligned with

- 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 English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects*

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

- Your **instructional objectives (IO)** for this lesson align with the NRC Framework.
- You will know that you have achieved these instructional objectives if students demonstrate the related **learning outcomes (LO)**, also aligned with the NRC Framework.
- 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 the NRC Framework. 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 NRC Framework for K-12 Science Education.

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 NRC Framework for K-12 Education. For convenience, a quick view follows:



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

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

What are the predictable patterns caused by Earth's movement in the solar system?

ESS1.B: Earth and the Solar System

Instructional Objective <i>Students will be able to</i>	Learning Outcomes <i>Students will demonstrate the measurable abilities</i>	Standards <i>Students will address</i>
IO1: Explain predictable eclipse patterns using a model to discover and demonstrate the evidence of phenomena at different scales such as the Moon's inclination (orbital plane) in combination with the position of the Sun, Earth, moon system.	LO1a: Use a model to discover and explain the arrangement of the Sun, Earth, Moon system to generate eclipses LO1b: Evaluate the arguments provided by advisory for the cause of solar and lunar eclipses based on ways of knowing. LO1c: Use a model to discover and explain the relationship between umbral diameter and likelihood of viewing an eclipse from Earth. LO1d: Use a model to investigate and explain the relationship of the Moon's inclination and the pattern of observed solar eclipses over time.	PRACTICES: <ol style="list-style-type: none"> 2. Developing and Using Models 4. Analyzing and Interpreting Data 6. Constructing Explanations and Designing Solutions 7. Engaging in Argument from Evidence 8. Obtaining, Evaluating, and Communicating information <p>Scientific Knowledge is Based on Empirical Evidence</p> <p>DISCIPLINARY CORE IDEAS:</p> <ol style="list-style-type: none"> 1. ESS1.A: The Universe and Its Stars 2. ESS1.B: Earth and the Solar System <p>CROSSCUTTING CONCEPTS:</p> <ol style="list-style-type: none"> 1. Patterns 2. Cause and Effect: Mechanism and Prediction 3. Scale, Proportion, and Quantity 4. Systems and System Models

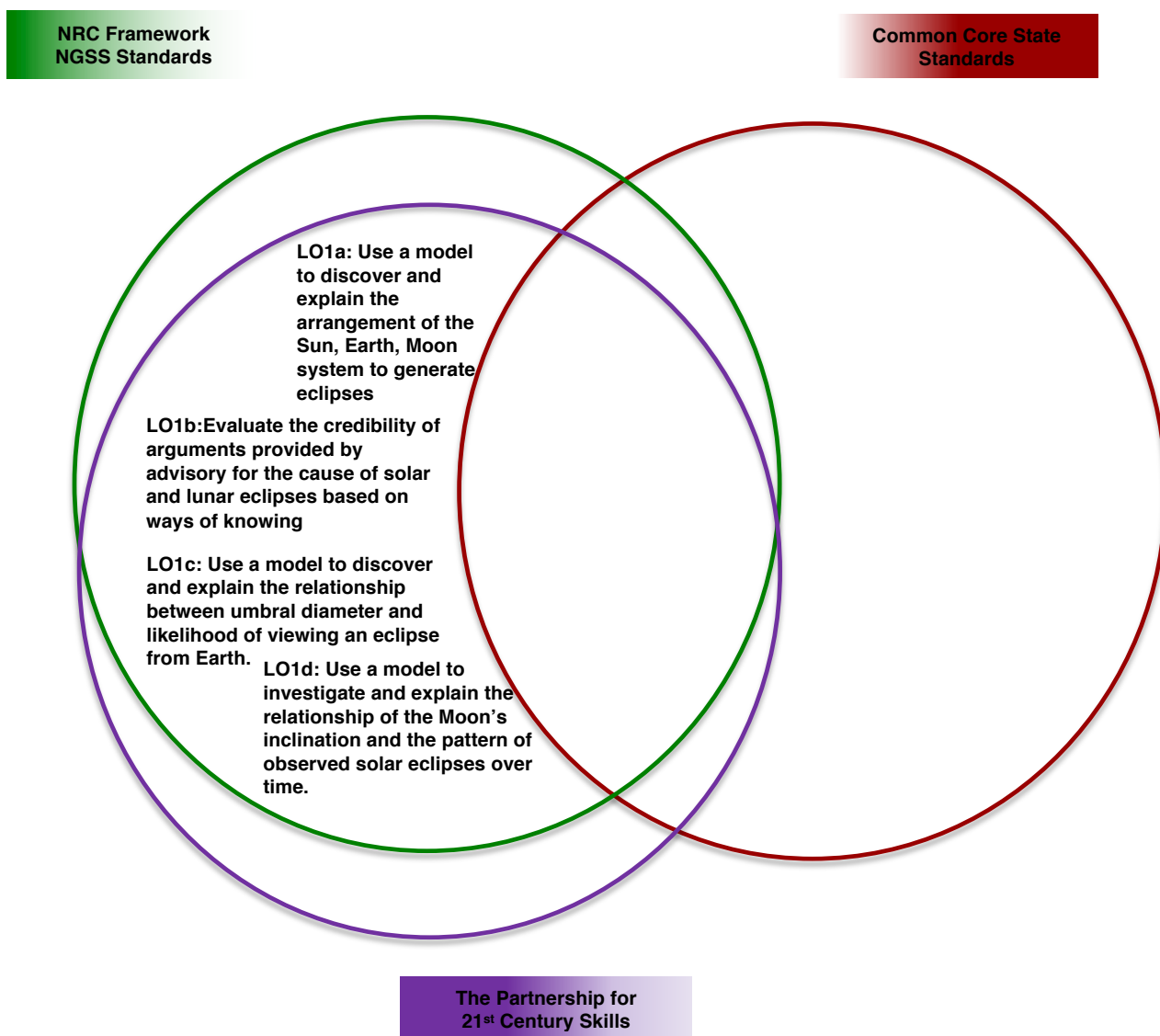
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3.0 Learning Outcomes, NRC Framework, NGSS, Common Core, & 21st Century Skills Connections

The connections diagram is used to organize the learning outcomes addressed in the lesson to establish where each 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 NGSS Alignment Document and Common Core State Standards Alignment Document for details on their specific alignments.





4.0 Evaluation/Assessment

Use the *(N) Kingdom in Peril Alignment Rubric* as a formative and summative assessment allowing students to improve their work and learn from mistakes during class, but also providing final assessment of learning activities. The rubric evaluates the activities using the NRC Framework.

5.0 References

- 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.
- Donovan, S. & Bransford, J. D. (2005). *How Students Learn: History, Mathematics, and Science in the Classroom*. Washington, DC: The National Academies Press.
- Miller, Linn, & Gronlund. (2009). *Measurement and assessment in teaching*. Upper Saddle River, NJ: Pearson.
- National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Committee on a Conceptual Framework for New K-12 Science Education Standards. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

(N) Teacher Resource. Kingdom in Peril NRC Framework for Science Education 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.

NRC Framework for K-12 Science Education			
Instructional Objective	Science and Engineering Practices Benchmark by Grade 8	Disciplinary Core Idea Grade Band Endpoints	Crosscutting Concepts
IO1: Explain predictable eclipse patterns using a model to discover and demonstrate the evidence of phenomena at different scales such as the Moon's inclination (orbital plane) in combination with the position of the Sun, Earth, Moon system.	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a system, particularly those not readily visible to the naked eye.</p> <p>Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further.</p> <p>Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence.</p> <p>Offer causal explanations appropriate to their level of scientific knowledge.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.</p> <p>Scale, Proportion, and Quantity Develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes and also to consider whether a numerical result sounds reasonable.</p> <p>Students acquire the ability as well to move back and forth between models at various scales, depending on the question being considered.</p>

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(M) Teacher Resource. The Search for Life NRC Framework for Science Education Alignment (2 of 3)

NRC Framework for K-12 Science Education			
Learning Outcomes	Science and Engineering Practices Benchmark by Grade 8	Disciplinary Core Idea Grade Band Endpoints	Crosscutting Concepts
LO1a: Use a model to discover and explain the arrangement of the Sun, Earth, Moon system to generate eclipses	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a system, particularly those not readily visible to the naked eye.</p> <p>Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further. Distinguish between causal and correlational relationships.</p> <p>Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence.</p> <p>Offer causal explanations appropriate to their level of scientific knowledge.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon.</p> <p>Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.</p> <p>Scale, Proportion, and Quantity Students develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes and also to consider whether a numerical result sounds reasonable.</p> <p>Students acquire the ability to move back and forth between models at various</p>

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			scales, depending on the question being considered.
LO1b: Evaluate the credibility of arguments provided by advisory for the cause of solar and lunar eclipses based on ways of knowing.	Engaging in Argument from Evidence Exploration of historical episodes in science can provide opportunities for students to identify the ideas, evidence, and arguments of professional scientists.	ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied. Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.
LO1c: Use a model to discover and explain the relationship between umbral diameter and likelihood of viewing an eclipse from Earth.	Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a system, particularly those not readily visible to the naked eye. Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further. Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence.	ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied. Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity. Scale, Proportion, and Quantity Students develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes and also

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	Offer causal explanations appropriate to their level of scientific knowledge.		to consider whether a numerical result sounds reasonable. Students acquire the ability to move back and forth between models at various scales, depending on the question being considered.
LO1d: Use a model to investigate and explain the relationship of the Moon's inclination and the pattern of observed solar eclipses over time.	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a system, particularly those not readily visible to the naked eye.</p> <p>Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further.</p> <p>Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence.</p> <p>Offer causal explanations appropriate to their level of scientific knowledge.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.</p> <p>Scale, Proportion, and Quantity Develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes and also to consider whether a numerical result sounds reasonable.</p> <p>Students acquire the ability to move back and forth between models at various scales, depending on the question being considered.</p>



(M) Teacher Resource. The Search for Life NRC Framework for Science Education Individual Activity Alignment (3 of 3)

NRC Framework for Science Education				
Activity	Phases of 5E Instructional Model	Science and Engineering Practices Benchmark by Grade 8	Disciplinary Core Idea Grade Band Endpoints	Crosscutting Concepts
(A) An Ominous Event	Engage			
Celestial Bodies Red Moon Rebellion Darkest Day	Explore	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a particular system, particularly those not readily visible to the naked eye.</p> <p>Planning and Carrying Out Investigations Formulate a question that can be investigated within the scope of the classroom, school laboratory, or field with available resources and, when appropriate, frame a hypothesis (that is, a possible explanation that predicts a particular and stable outcome) based on a model or theory.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the</p>	<p>Patterns Recognize, classify, and record patterns in a phenomena. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Scale, Proportion, and Quantity Develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes but also to consider whether a numerical result sounds reasonable. Students acquire the ability to move back and forth between models at various scales, depending on the question being considered.</p>

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		Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further. Distinguish between causal and correlational relationships.	planets in the sky relative to the stars.	Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.
(B) Modeling the Sun-Earth-Moon System Recording Sheet (D) Solar and Lunar Eclipses Recording Sheet (E) Investigating Eclipses	Explore Explain	Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a system, particularly those not readily visible to the naked eye. Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further. Distinguish between causal and correlational relationships. Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence. Offer causal explanations appropriate to their level of scientific knowledge.	ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied. Scale, Proportion, and Quantity Students develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes but also to consider whether a numerical result sounds reasonable. Students acquire the ability as well to move back and forth between models at various scales, depending on the question being considered. Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.

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(C) Selecting a Royal Advisor Recording Sheet	Explore Explain	<p>Engaging in Argument from Evidence Exploration of historical episodes in science can provide opportunities for students to identify the ideas, evidence, and arguments of professional scientists.</p> <p>Obtaining, Evaluating and Communicating Information Evaluate the scientific validity of the information thus acquired, and to integrate that information into a conceptual framework.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon.</p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity.</p>
(F) Confronting Flaws Recording Sheet	Explore Explain	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a particular system, particularly those not readily visible to the naked eye.</p> <p>Refine a model in light of empirical evidence or criticism to improve its quality and explanatory power.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity. Students ask about cause-and-effect relationships in</p>

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		<p>Analyzing and Interpreting Data Recognize patterns in data that suggest relationships worth investigating further.</p> <p>Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence.</p> <p>Offer causal explanations appropriate to their level of scientific knowledge.</p>	held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	the system studied, particularly when something occurs that is unexpected.
(G-1) Modeling Eclipses in Other Sun-Planet-Moon Systems	Elaborate	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a particular system, particularly those not readily visible to the naked eye</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar system can explain tides, eclipses of the Sun and the Moon, and the motion of the</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Scale, Proportion, and Quantity Develop an understanding of estimation across scales and contexts, which is important for making sense of data.</p> <p>Develop a sense of the size and time scales relevant to various objects, systems, and processes but also to consider whether a numerical result sounds reasonable. Students acquire the ability as well to move back and forth between models at</p>



			planets in the sky relative to the stars.	<p>various scales, depending on the question being considered.</p> <p>Systems and System Models Identify the assumptions and approximations that have been built into a model and discuss how they limit the precision and reliability of its predictions. <i>(Connect to High School Crosscutting Statements)</i></p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity. Students ask about cause-and- effect relationships in the system studied, particularly when something occurs that is unexpected.</p>
(G-2) Criterion for Eclipse Modeling	Elaborate	<p>Developing and Using Models Use (provided) computer simulations or simulations developed with simple simulation tools as a tool for understanding and investigating aspects of a particular system, particularly those not readily visible to the naked eye.</p> <p>Communicate scientific and/or technical information Engage in discussion about observations and conclusions with other students by asking questions and discussing issues raised.</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Scale, Proportion, and Quantity Develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes but also to consider whether a numerical result sounds reasonable.</p>



			system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	<p>Students acquire the ability to move back and forth between models at various scales, depending on the question being considered.</p> <p>Systems and System Models Students should be able to identify the assumptions and approximations that have been built into a model and discuss how they limit the precision and reliability of its predictions. (<i>Connect to High School Crosscutting Statements</i>)</p> <p>Cause and Effect: Mechanism and Prediction Students ask about cause-and- effect relationships in the system studied, particularly when something occurs that is unexpected.</p>
(H) Explaining Earth's Eclipse Patterns	Evaluate	<p>Constructing Explanations and Designing Solutions Construct their own explanations of phenomena using their knowledge of accepted scientific theory and linking it to models and evidence.</p> <p>Offer causal explanations appropriate to their level of scientific knowledge.</p> <p>Obtaining, Evaluating, and Communicating Information Use words, tables, diagrams, and graphs to communicate their</p>	<p>ESS1.A: The Universe and Its Stars Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.</p> <p>ESS1.B: Earth and the Solar System The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. This model of the solar</p>	<p>Patterns Recognize, classify, and record patterns in a phenomenon. Recognize that different patterns may be observed at each of the scales at which a system is studied.</p> <p>Cause and Effect: Mechanism and Prediction Understand the cause-effect relationships between events that occur together with regularity. Students ask about cause-and- effect relationships in the system studied, particularly when something occurs that is unexpected.</p> <p>Scale, Proportion, and Quantity</p>

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		understanding of a system under study.	system can explain tides, eclipses of the Sun and the Moon, and the motion of the planets in the sky relative to the stars.	Develop an understanding of estimation across scales and contexts, which is important for making sense of data. Students develop a sense of the size and time scales relevant to various objects, systems, and processes but also to consider whether a numerical result sounds reasonable.
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**(N) Teacher Resource. Kingdom in Peril NRC Alignment Rubric (1 of 2)****Related Rubrics for the Assessment of Learning Outcomes Associated with the Above Standard(s):****NRC Framework for Science Education Alignment**

Learning Outcomes	Expert	Proficient	Intermediate	Beginner
LO1a: Use a model to discover and explain the arrangement of the Sun, Earth, Moon system to generate eclipses	Accurately draws arrangement of the Sun, Earth, Moon system and fully describes the shadows related to their arrangement.	Accurately draws the arrangement of the Sun, Earth, Moon system and indicates the shadows related to their arrangement.	Draws the arrangement of the Sun, Earth, Moon system and states that shadows make eclipses.	Draws the arrangement of the Sun, Earth, Moon system.
LO1b: Evaluate the credibility of arguments provided by advisory for the cause of solar and lunar eclipses based on ways of knowing.	Accurately identifies the ways of knowing for advisory and articulates that science is a more credible way of knowing due to the use of evidence, logic and reasoning as opposed to arguments based on myths, spiritual or religious beliefs.	Accurately identifies the ways of knowing for advisory and articulates that science is a more credible way of knowing due to the use of evidence.	Identifies the ways of knowing for advisory and states that science is a more credible way of knowing.	Identifies the ways of knowing for advisory.
LO1c: Use a model to discover and explain the relationship between umbral shadow diameter and likelihood of viewing an eclipse from Earth.	Accurately collects relevant data and fully explains the difference between the diameter of the umbral shadow and the likelihood of observing a solar versus a lunar eclipse, referencing the duration of the eclipse and the portion of Earth that is able to see the eclipse.	Accurately collects relevant data and fully explains the difference between the diameter of the umbral shadow and the likelihood of observing a solar versus a lunar eclipse, referencing the duration of the eclipse or the portion of Earth able to see the eclipse.	Collects data and states that lunar eclipses are seen by about half the Earth and solar eclipses are seen by much less than half the Earth.	Collects data and states that blood Moons are caused by Earth's shadow.
LO1d: Use a model to investigate and explain the relationship of the Moon's inclination and the pattern of observed solar eclipses over time.	Accurately collects data from each adjustment to the model and fully explains that the observed pattern of eclipses is attained when the Moon's orbit is tilted 5° with respect to Earth's orbit. Explanation includes discussion of the model's problem of predicting eclipses more frequently than actually observed.	Accurately collects data from each adjustment to the model and explains that the observed pattern of eclipses is only attained when the Moon's orbit is tilted 5° with respect to Earth's orbit.	Accurately collects data and states that 5° tilt of the Moon's orbit properly predicts eclipses.	Collects data and states that 5° tilt is correct.

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**(N) Teacher Resource. Kingdom in Peril NRC Alignment Rubric (2 of 2)**

Related Rubrics for the Assessment of Instructional Objective Associated with the Above Standard(s):

NRC Framework for Science Education Alignment

Instructional Outcome	Expert	Proficient	Intermediate	Beginner
IO1: Explain predictable eclipse patterns using a model to discover and demonstrate the evidence of phenomena at different scales such as the Moon's inclination (orbital plane) in combination with the position of the Sun, Earth, Moon system.	Provides detailed, accurate, diagrams of the Sun, Earth, Moon system arrangement with the shadows in lunar and solar eclipses including Moon's inclination and all appropriate labels. Fully explains the patterns related to eclipses including references to frequency due to inclination, the positioning of the Sun, Earth, Moon system, and the relationship between the size of the shadow observed on Earth and the size of the body casting the shadow, using appropriate vocabulary, data from collection, and detailed observations.	Provides accurate, diagrams of the arrangement of the Sun, Earth, Moon system in lunar and solar eclipses with most appropriate labels. Explains the patterns related to eclipses including references to frequency due to inclination, the positioning of the Sun, Earth, Moon system, and the relationship between the size of the shadow observed on Earth and the size of the body casting the shadow, using some appropriate vocabulary, data from collection, and observations.	Provides accurate diagrams of the arrangement of the Sun, Earth, Moon system in lunar and solar eclipses with some labels. Accurately explains the patterns related to eclipses including references to the positioning of the Sun, Earth, Moon system and the size of the shadow cast upon Earth.	Provides diagrams of the arrangement of the Sun, Earth, Moon system in lunar or solar eclipses. States the arrangement that produces solar and lunar eclipses.