

# kingdom in peril





# Kingdom in Peril

## Middle School Next Generation Science Standards 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 17<sup>th</sup> 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

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

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

- Your **instructional objective (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 are the predictable patterns caused by Earth's movement in the solar system?

ESS1.B: Earth and the Solar System

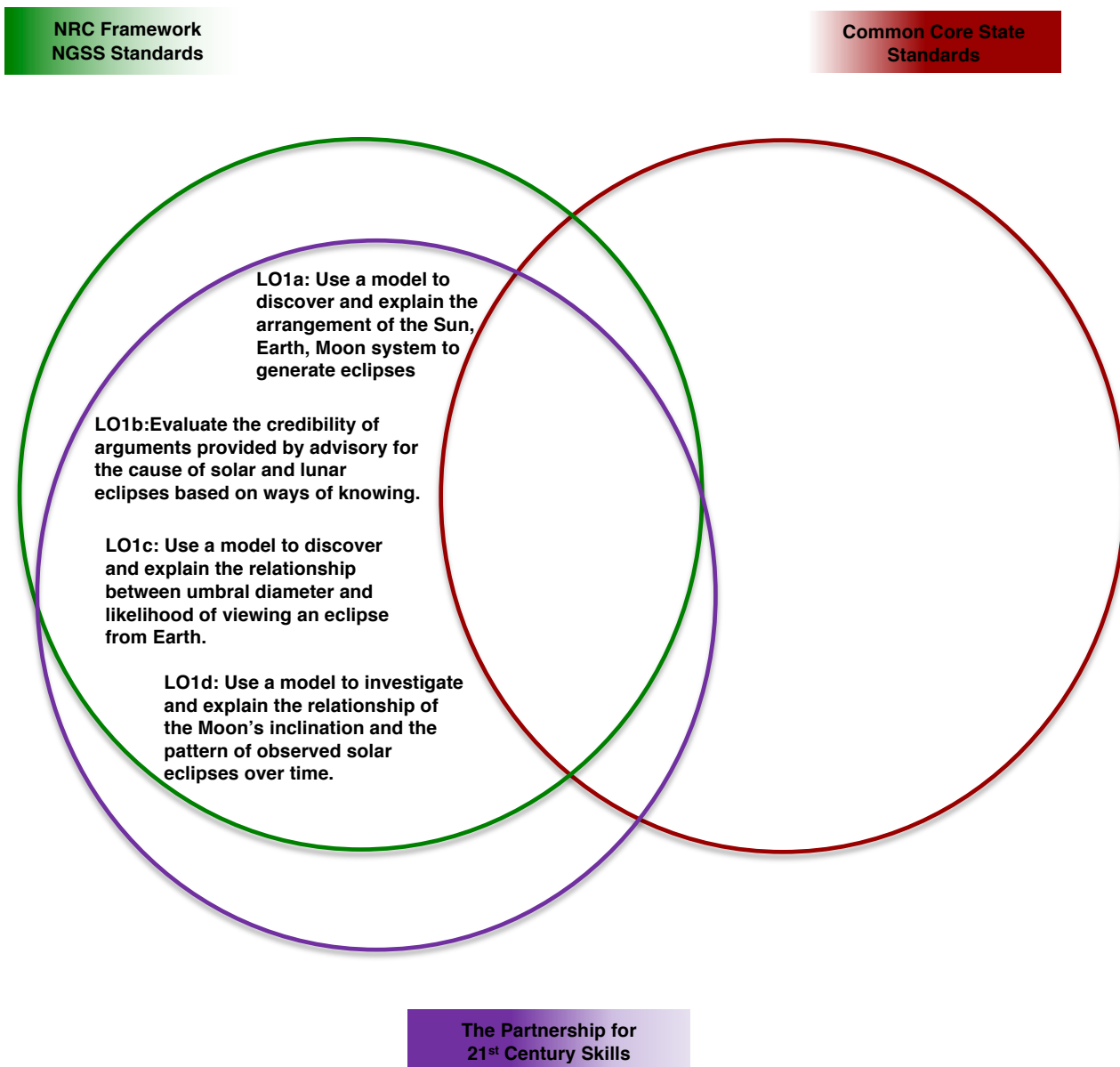
Instructional Objective Students will be able to	Learning Outcomes Students will demonstrate the measurable abilities	Standards Students will address
<b>IO1: Explain predictable eclipse patterns using a model to discover and demonstrate the evidence of phenomena at different scales such as the Moon's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

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### 3.0 Learning Outcomes, NRC Framework, NGSS, Common Core, & 21<sup>st</sup> 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 21<sup>st</sup> 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 the learning activities. 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.
- 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* 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: (MS-ESS1.A), (MS-ESS1.B).

 Next Generation Science Standards			
Instructional Objective	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
<b>IO1:</b> <b>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.</b>	<b>Constructing Explanations and Designing Solutions</b> Construct a scientific explanation using models or representations based on valid and reliable evidence obtained from sources (including the student's own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.  <b>Developing and Using Models</b> Use and revise models to describe, test, and predict abstract phenomena and design systems  <b>Analyzing and Interpreting Data</b>	<b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)  <b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)	<b>Patterns</b> Patterns can be used to identify cause-and-effect relationships.  <b>Cause and Effect: Mechanism and Prediction</b> Cause and effect relationships may be used to predict phenomena in natural or designed systems.  <b>Scale, Proportion, and Quantity</b> Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Phenomena that can be observed at one scale may not be observable at another scale.  <b>Scientific knowledge Assumes an Order and Consistency in Natural Systems</b> Science Assumes that objects and events in natural systems occur in consistent patterns that

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	Analyze and interpret data to determine similarities and differences in findings.		are understandable through measurement and observation.  Empirical evidence is needed to identify patterns. <i>(Connect to High School Crosscutting Statements)</i>
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(M) Teacher Resource. *Kingdom in Peril* NGSS Alignment (2 of 3)

Next Generation Science Standards			
Learning Outcomes	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
<b>LO1a:</b> Use a model to discover and explain the arrangement of the Sun, Earth, Moon system to generate eclipses	<b>Constructing Explanations and Designing Solutions</b> Construct an explanation that includes qualitative or quantitative relationships between variable that predict(s) and/or describe(s) phenomena  Construct an explanation using models or representations.  <b>Developing and Using Models</b> Use a model to predict and/or describe phenomena.  <b>Analyzing and Interpreting Data</b> Analyze and interpret data to provide evidence for phenomena.	<b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)  <b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)	<b>Patterns</b> Patterns can be used to identify cause and effect relationships.  Empirical evidence is needed to identify patterns. ( <i>Connect to High School Crosscutting Statements</i> )  <b>Cause and Effect: Mechanism and Prediction:</b> Cause and effect relationships may be used to predict phenomena in natural or designed systems.
<b>LO1b:</b> Evaluate the credibility of arguments provided by advisory for the cause of solar and lunar	<b>Obtaining, Evaluating, and Communicating Information</b> Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.	<b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)	<b>Cause and Effect: Mechanism and Prediction:</b> Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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<p><b>eclipses based on ways of knowing.</b></p>	<p><b>Scientific Investigations Use a Variety of Methods</b> Scientific values function as criteria in distinguishing between science and non-science</p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b> Science knowledge is based upon logical and conceptual connections between evidence and explanations.</p>	<p><b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses of the Sun and the Moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the differential intensity of Sunlight on different areas of Earth across the year. (MS-ESS1-1)</p>	<p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p> <p><b>Science Addresses Questions About the Natural and Material World</b> Science limits its explanations to systems that lend themselves to observation and empirical evidence.</p> <p><b>Science is a Way of Knowing</b> Science is a way of knowing used by many people, not just scientists.</p> <p>Science knowledge has a history that includes the refinement of, and changes to, theories, ideas, and beliefs over time. <i>(Connection to High School Crosscutting Concepts)</i></p>
<p><b>LO1c:</b> <b>Use a model to discover and explain the relationship between umbral diameter and likelihood of viewing an eclipse from Earth.</b></p>	<p><b>Developing and Using Models</b> Use a model to predict and/or describe phenomena.</p> <p><b>Analyzing and Interpreting Data</b> Analyze and interpret data to provide evidence for phenomena.</p> <p><b>Constructing Explanations and Designing Solutions</b> Construct an explanation that includes qualitative or quantitative relationships</p>	<p><b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b></p>	<p><b>Patterns</b> Patterns can be used to identify cause and effect relationships.</p> <p><b>Cause and Effect: Mechanism and Prediction:</b> Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p> <p><b>Scale, Proportion, and Quantity</b> Phenomena that can be observed at one</p>


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	<p>between variable that predict(s) and/or describe(s) phenomena</p> <p>Construct an explanation using models or representations.</p>	<p>This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)</p>	<p>scale may not be observable at another scale.</p>
<p><b>LO1d:</b>  <b>Use a model to investigate and explain the relationship of the Moon's inclination and the pattern of observed solar eclipses over time.</b></p>	<p><b>Planning and Carrying Out Investigations</b>          Collect data to serve as the basis for evidence to answer scientific questions.</p> <p><b>Developing and Using Models</b>          Use a model to predict and/or describe phenomena.</p> <p><b>Analyzing and Interpreting Data</b>          Analyze and interpret data to provide evidence for phenomena.</p> <p><b>Constructing Explanations and Designing Solutions</b>          Construct an explanation that includes qualitative or quantitative relationships between variable that predict(s) and/or describe(s) phenomena</p> <p>Construct an explanation using models or representations.</p>	<p><b>ESS1.A: The Universe and Its Stars</b>          Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b>          This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)</p>	<p><b>Patterns</b>          Patterns can be used to identify cause and effect relationships.</p> <p><b>Cause and Effect: Mechanism and Prediction:</b>          Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p> <p><b>Scale, Proportion, and Quantity</b>          Phenomena that can be observed at one scale may not be observable at another scale.</p>



(N) Teacher Resource. *Kingdom in Peril* 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
(A) An Ominous Event	Engage			
Celestial Bodies  Red Moon Rebellion  Darkest Day	Explore	<p><b>Obtaining, Evaluating, and Communicating Information</b>            Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.</p> <p><b>Planning and Carrying Out Investigations</b>            Collect data to serve as the basis for evidence to answer scientific questions.</p> <p><b>Developing and Using Models</b>            Use a model to predict and/or describe phenomena.</p> <p><b>Analyzing and Interpreting Data</b>            Analyze and interpret data to provide evidence for phenomena.</p>	<p><b>ESS1.A: The Universe and Its Stars</b>            Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b>            This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)</p>	<p><b>Patterns</b>            Empirical evidence is needed to identify patterns</p> <p><b>Cause and Effect: Mechanism and Prediction:</b>            Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p> <p><b>Scale, Proportion, and Quantity</b>            Phenomena that can be observed at one scale may not be observable at another scale.</p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b>            Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</p>
(B) Modeling	Explore			

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<p><b>the Sun-Earth-Moon System Recording Sheet</b></p> <p><b>(D) Solar and Lunar Eclipses Recording Sheet</b></p> <p><b>(E) Investigating Eclipses</b></p>	<p><b>Explain</b></p>	<p><b>Developing and Using Models</b> Use a model to predict and/or describe phenomena.</p> <p><b>Obtaining, Evaluating, and Communicating Information</b> Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.</p> <p><b>Analyzing and Interpreting Data</b> Analyze and interpret data to provide evidence for phenomena.</p>	<p><b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p>	<p><b>Patterns</b> Empirical evidence is needed to identify patterns</p> <p><b>Cause and Effect: Mechanism and Prediction:</b> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p> <p><b>Scale, Proportion, and Quantity</b> Phenomena that can be observed at one scale may not be observable at another scale.</p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</p>
<p><b>(C) Selecting a Royal Advisor Recording Sheet</b></p>	<p><b>Explore Explain</b></p>	<p><b>Engaging in Argument from Evidence</b> Use an oral and written argument supported by evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon</p> <p><b>Obtaining, Evaluating, and Communicating Information</b> Gather, read, synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and</p>	<p><b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses</p>	<p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</p>

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		<p>methods used, and describe how they are supported or not supported by evidence.</p> <p><b>Scientific Knowledge is Based on Empirical Evidence</b> Science knowledge is based upon logical and conceptual connections between evidence and explanations.</p>	of the Sun and the Moon. (MS-ESS1-1)	
<b>(F) Confronting Flaws Recording Sheet</b>	<b>Explore Explain</b>	<p><b>Planning and Carrying Out Investigations</b> Collect data to serve as the basis for evidence to answer scientific questions.</p> <p><b>Developing and Using Models</b> Use a model to predict and/or describe phenomena.</p> <p>Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.</p> <p><b>Analyzing and Interpreting Data</b> Analyze and interpret data to provide evidence for phenomena.</p>	<p><b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)</p>	<p><b>Patterns</b> Empirical evidence is needed to identify patterns</p> <p><b>Cause and Effect: Mechanism and Prediction:</b> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</p>



<b>(G) Modeling Eclipses in Other Sun-Planet-Moon Systems</b>	<b>Elaborate</b>	<p><b>Developing and Using Models</b> Use a model to predict and/or describe phenomena.</p> <p><b>Analyzing and Interpreting Data</b> Analyze data using tools, technologies, and/or models in order to make valid and reliable scientific claims.</p>	<p><b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)</p>	<p><b>Patterns</b> Empirical evidence is needed to identify patterns</p> <p><b>Cause and Effect: Mechanism and Prediction:</b> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b> Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</p>
<b>(H) Explaining Earth's Eclipse Patterns</b>	<b>Evaluate</b>	<p><b>Constructing Explanations and Designing Solutions</b> Construct a scientific explanation using models or representations based on valid and reliable evidence obtained from sources (including the student's own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</p> <p><b>Obtaining, Evaluating, and Communicating Information</b> Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.</p>	<p><b>ESS1.A: The Universe and Its Stars</b> Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)</p> <p><b>ESS1.B: Earth and the Solar System</b> This model of the solar system can explain eclipses of the Sun and the Moon. (MS-ESS1-1)</p>	<p><b>Patterns</b> Empirical evidence is needed to identify patterns</p> <p><b>Cause and Effect: Mechanism and Prediction:</b> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</p> <p><b>Scientific knowledge Assumes an Order and Consistency in Natural Systems</b> Science Assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.</p>

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**(N) Teacher Resource. *Kingdom in Peril* NGSS Alignment Rubric (1 of 2)****Related Rubrics for the Assessment of Learning Outcomes Associated with the Above Standard(s):****Next Generation Science Standards Alignment (NGSS)**

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* NGSS Alignment Rubric (1 of 2)

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



## Next Generation Science Standards Alignment (NGSS)

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.