



moon phases



Phases of the Moon

Middle School Next Generation Science Standards Alignment Document



WHAT STUDENTS DO: Use a model to reprogram a “telescope” to clear photos

Students use a model to identify inaccuracies in LuCIA’s coding. They will need to successfully sequence a variety of Moon phase diagrams to “Reprogram” her code. Students will test the new code to determine the clarity of galaxy image and reprogram until a clear image is achieved.

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: Use a model to generate and explain the phenomenon of moon phase sequence (effect) and the arrangement/orbit of the Sun, Earth, Moon system (cause).

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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/phases-of-the-moon/> for access to the digital learning experience 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*

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 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>
<p>IO1: Use a model to generate and explain the phenomenon of moon phase sequence (effect) and the arrangement / orbit of the Sun, Earth, Moon system (cause).</p>	<p>LO1a: Ask questions from observation of phenomena in order to identify the cause and effect relationship of the Sun, Earth, and Moon arrangement in phases of the moon.</p> <p>LO1b: Use a model to explore and explain the cause and effect relationship of the view from Earth, reflection of Sun's radiation, and the pattern of Moon phases.</p> <p>LO1c: Use a model to explore and explain the cause and effect relationship between the arrangement of the Sun, Earth, and Moon and the pattern of Moon phases.</p>	<p>PRACTICES:</p> <ol style="list-style-type: none"> 1. Asking Questions and Defining Problems 2. Developing and Using Models 3. Constructing Explanations and Designing Solutions 4. Obtaining, Evaluating, and Communicating Information <p>DISCIPLINARY CORE IDEAS: ESS1.A: The Universe and its Stars</p> <p>CROSSCUTTING CONCEPTS:</p> <ol style="list-style-type: none"> 1. Patterns 2. Cause and Effect

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3.0 Evaluation/Assessment

Use the *(N) Phases of the Moon 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).

4.0 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.
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- National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards*. Washington, DC: Authors.
- 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.
- 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. Phases of the Moon 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-ESS1-1)

 Next Generation Science Standards			
Instructional Objective	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
IO1: Use a model to generate and explain the phenomenon of moon phase sequence (effect) and the arrangement/orbit of the Sun, Earth, Moon system (cause).	Developing and Using Models Use a model to predict and/or describe phenomena. Constructing Explanations and Designing Solutions Construct an explanation using models or representations.	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.	Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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(M) Teacher Resource. Phases of the Moon NGSS Alignment (2 of 3)

 Next Generation Science Standards			
Learning Outcomes	Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
LO1a: Ask questions from observation of phenomena in order to identify the cause and effect relationship of the Sun, Earth, and Moon arrangement in phases of the moon.	Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena to clarify and/or seek additional information.	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	Patterns Patterns can be used to identify cause and effect relationships. Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.
LO1b: Use a model to explore and explain the cause and effect relationship of the view from Earth, reflection of Sun's radiation, and the pattern of Moon phases.	Developing and Using Models Use a model to describe phenomena. Constructing Explanations and Designing Solutions Construct an explanation using models or representations.	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	Patterns Patterns can be used to identify cause and effect relationships. Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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<p>LO1c: Use a model to explore and explain the cause and effect relationship between the arrangement of the Sun, Earth, and Moon and the pattern of Moon phases.</p>	<p>Developing and Using Models Use a model to describe phenomena.</p> <p>Constructing Explanations and Designing Solutions Construct an explanation using models or representations.</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>Patterns Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p>
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(M) Teacher Resource. Phases of the Moon 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
The Moon and Libration (A) Moon Phases Observations Recording Sheet	Engage	Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena to clarify and/or seek additional information.	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	Patterns Patterns can be used to identify cause and effect relationships. Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Phases of the Moon Exploratory Activity (B) Phases Recording Sheet (C) Answers to My Questions Recording Sheet	Explore / Explain	Developing and Using Models Use a model to describe phenomena. Constructing Explanations and Designing Solutions Construct an explanation using models or representations.	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	Patterns Patterns can be used to identify cause and effect relationships. Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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<p>(D) Answering Open Questions</p>	<p>Elaborate</p>	<p>Obtaining, Evaluating, and Communicating Information Critically read scientific texts adapted for classroom use to determine the central ideas, and/or obtain scientific information to describe patterns in and/or evidence about the natural world.</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>Patterns Patterns can be used to identify cause and effect relationships.</p> <p>Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p>
<p>(E) Phases of the Moon Evaluation</p>	<p>Evaluate</p>	<p>Developing and Using Models Use a model to predict and/or describe phenomena.</p> <p>Constructing Explanations and Designing Solutions Construct an explanation using models or representations.</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>Cause and Effect: Mechanisms and Prediction Cause and effect relationships may be used to predict phenomena in natural or designed systems.</p>

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(N) Teacher Resource. Phases of the Moon NGSS Alignment Rubric

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


 Next Generation Science Standards Alignment (NGSS)

Instructional Objective	Expert	Proficient	Intermediate	Beginner
IO1: Use a model to generate and explain the phenomenon of moon phase sequence (effect) and the arrangement/orbit of the Sun, Earth, Moon system (cause).	Student accurately represents the arrangement of the Sun, Earth and Moon, the view from Earth, and the correct sequence of an assigned Moon phase in text and diagrams . Student articulates this is a natural phenomenon with a repeating pattern due to the illumination of the Moon by the Sun and the position of the Moon in orbit around the Earth.	Student accurately represents the arrangement of the Sun, Earth and Moon, the view from Earth, and the correct sequence of an assigned Moon phase . Student articulates this is a natural phenomenon with a repeating pattern due to the illumination of the Moon by the Sun and the position of the Moon in orbit around the Earth.	Student represents the arrangement of the Sun, Earth and Moon, the view from Earth, and the sequence of a Moon phase. Student articulates this is a natural phenomenon with a repeating pattern due to the illumination of the Moon by the Sun and the position of the Moon in orbit around the Earth.	Student represents the arrangement of the Sun, Earth and Moon, the view from Earth, and the sequence of different Moon phases and completes the fill in activity.

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PHASES OF THE MOON

Teacher Guide

(N) Teacher Resource. Phases of the Moon NGSS Alignment Rubric

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


 Next Generation Science Standards Alignment (NGSS)

Learning Outcome	Expert	Proficient	Intermediate	Beginner
LO1b: Use a model to explore and explain the cause and effect relationship of the view from Earth, reflection of Sun's radiation, and the pattern of Moon phases.	Student accurately represents illumination of the Moon and the view from Earth patterns in all diagrams. Includes an explanation that half of the Moon is always lit from solar radiation , but our view from Earth and the position of the Moon will determine what phase we observe on Earth.	Student accurately represents illumination of the Moon and the view from Earth patterns in all diagrams. Includes an explanation that half of the Moon is always lit, but our view from Earth and the position of the Moon will determine what phase we observe on Earth.	Student represents illumination of the Moon and the view from Earth patterns in at least one diagram. Includes an explanation that half of the Moon is lit.	Student discusses that half of the Moon is lit.
LO1c: Use a model to explore and explain the cause and effect relationship between the arrangement of the Sun, Earth, and Moon and the pattern of Moon phases.	Student accurately represents the arrangement of the Sun, Earth, and Moon in all diagrams. Description includes references to the model with different Moon phases viewed from Earth due to movement of the Moon during the 28 days as the Moon orbits Earth.	Student accurately represents the arrangement of the Sun, Earth, and Moon in all diagrams. Description includes references to the model with different Moon phases viewed from Earth.	Student represents the arrangement of the Sun, Earth, and Moon in all diagrams. Description includes references to different Moon phases viewed from Earth.	Student represents the arrangement of the Sun, Earth, and Moon in all diagrams.

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