NGSS UNIT OVERVIEW

SOLAR SYSTEM AND BEYOND

Performance Expectation MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

Performance Expectation MS-ESS1-2: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

Performance Expectation MS-ESS1-3: Analyze and interpret data to determine scale properties of objects in the solar system.

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
1. **Talking it Over: Exploring Space** Students learn how space exploration has expanded our understanding of the Solar System and beyond. Students consider the challenges involved with space exploration. They learn how advances in engineering and technology have made space exploration possible.	MS-ESS1.A	Connections to Nature of Science: Science Knowledge Is Open to Revision in Light of New Evidence Analyzing and Interpreting Data	Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology	ELA/Literacy: RST.6-8.1 WHST.6-8.9
2. **Investigation: The Predictable Moon** Students start by ordering the phases of the Moon based on their own experiences and observations of the Moon. They then are challenged to figure out whether there is a predictable, and repeating, pattern in how the Moon's appearance changes over time. Using the pattern they discover, they analyze an incomplete moon phase calendar and determine which phases occur on the missing days.	MS-ESS1.A	Analyzing and Interpreting Data	Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Patterns	
3. **Modeling: Explaining the Moon's Phases** Students use a physical model to understand how the interactions within the Earth-Sun-Moon system causes each phase of the Moon to have the appearance it has. To do this, students use a model to determine how light from the Sun makes different amounts of the Moon visible from Earth depending on where the Moon is relative to Earth and the Sun. They connect these observations with the pattern identified in the previous activity to build a better understanding of what causes the Moon's phases.	MS-ESS1.A MS-ESS1.B	Developing and Using Models	Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Patterns Systems and System Models Cause and Effect	ELA/Literacy: WHST.6-8.2

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
4. **Computer Simulation: Moon Phase Simulation** Students interact with a computer simulation that models the Moon's orbit around Earth. Students record data on how the Moon's appearance changes as its position in its orbit around Earth changes. They then analyze and interpret their data to identify the causes of the cyclic pattern of the Moon's phases.	MS-ESS1.A	Analyzing and Interpreting Data Developing and Using Models	Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Patterns Systems and System Models Scale, Proportion, and Quantity Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology	
5. **Modeling: The Moon's Orbit** Students develop and use a three-dimensional model that illustrates how the Moon's orbital plane is not aligned with Earth's orbital plane around the Sun. This phenomenon explains why there are solar and lunar eclipses a few times a year but not each lunar cycle. This activity provides an assessment opportunity for the first part of Performance Expectation MS-ESS1-1 relating to the Earth–Moon–Sun system. The second part of Performance Expectation MS-ESS1-1 relating to Earth's tilt and seasons is assessed in the "Earth on the Move" activity.	MS-ESS1.A MS-ESS1.B	Analyzing and Interpreting Data Developing and Using Models	Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Patterns	Mathematics: 6.RP.A.1 ELA/Literacy: WHST.6-8.2
6. **Investigation: Changing Sunlight** The previous sequence of activities focused on how the Moon's appearance changes over time. Students may recall from 5th grade NGSS Earth and Space Science that the Sun's position in the sky, and how long the Sun is up in the sky (above the horizon for a given location on a given day), also changes over time. This activity has students analyze and interpret 2 years of data related to the Sun's angle and the number of daylight hours in order to identify the patterns in these changes.	MS-ESS1.A MS-ESS1.B	Analyzing and Interpreting Data	Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
7. **Computer Simulation: A Year Viewed from Space** Students use an interactive simulation to view Earth's orbit around the Sun. The scale used in this model allows students to observe what Earth's tilt is and how Earth's tilt is related to the number of hours the Sun is up during the different months of the year. Students analyze and interpret data to determine that Earth's distance from the Sun doesn't change much over the year and is actually closest to the Sun in early January.	MS-ESS1.A MS-ESS1.B	Developing and Using Models Analyzing and Interpreting Data	Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Scale, Proportion, and Quantity Systems and System Models	ELA/Literacy: SL.8.5
8. **Modeling: Earth's Tilt** Students use a model to determine how the angle of the Sun relates to the amount of solar energy received at a given area on Earth's surface. Students model how Earth's tilt affects the interaction between solar energy and Earth's surface in the Earth-Sun system. To do this, students test how the angle of a solar cell, relative to the direction of incoming sunlight, affects the amount of electricity produced by the solar cell. This model allows students to observe why the angle of the Sun is related to the pattern of seasonal changes experienced on Earth.	MS-ESS1.B	Developing and Using Models	Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Systems and System Models	Mathematics: 6.RP.A.3
9. **Reading: Earth on the Move** Students read about how Earth's tilt relative to its orbital plane is the reason for the seasonal changes we experience on Earth's surface. The reading prompts students to think about how both the amount and intensity of daylight are related to the temperature at Earth's surface and how changes in temperature relate to the seasons. This activity provides an assessment opportunity for the second part of Performance Expectation MS-ESS1-1 relating to Earth's tilt and seasons. The first part of Performance Expectation MS-ESS1-1 relating to the Earth, Moon, and Sun system is assessed in "The Moon's Orbit" activity.	MS-ESS1.A MS-ESS1.B	Developing and Using Models	Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology	ELA/Literacy: RST.6-8.2 SL.8.5 WHST.6-8.2

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
10. **Investigation: Observing Objects in Space** Now that students have experience with observing patterns to better understand phenomena, they are asked to think about objects that are much farther away and more difficult to observe. Students are first given images of space objects as viewed from Earth to help them recognize how difficult it is to tell how big or far something is based on just a picture. Then students are shown images that have been taken with advanced technologies so they can analyze data to categorize the different objects found in our Solar System and beyond.	MS-ESS1.A MS-ESS1.B	Analyzing and Interpreting Data Using Mathematics and Computational Thinking	Scale, Proportion, and Quantity Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology	Mathematics: 6.RP.A.1
11. **Modeling: Drawing the Solar System** To help students understand the size and scale of the Solar System, they are tasked with developing a scale model of the distances between the Sun and the different planets in our Solar System. To test whether their scale works, they are asked to draw the distances between the Sun and each of the planets on a single piece of paper, making sure their distances are scaled properly.	MS-ESS1.B	Developing and Using Models Analyzing and Interpreting Data	Systems and System Models Scale, Proportion, and Quantity	Mathematics: MP.2 6.RP.A.1
12. **Project: Reading How Big Are the Planets?** While the scale used in the previous activity works for planetary distances, a different scale is needed to compare the sizes of planets. For this activity, students find different-sized objects in order to create a scale model of the size of the different planets in the Solar System. This model helps students describe the similarities and differences in the sizes of the planets.	MS-ESS1.B	Developing and Using Models Analyzing and Interpreting Data	Scale, Proportion, and Quantity	Mathematics: 6.RP.A.1 ELA/Literacy: SL.8.4 WHST.6-8.2
13. **Investigation: Identifying Planets** In this activity, students are given data corresponding to scaled properties of different planets in the Solar System. They then analyze and interpret the data to determine which planet each set of data corresponds to. Students are also introduced to different space missions that took place in order to collect the type of data analyzed in this activity. This activity provides an opportunity to assess Performance Expectation MS-ESS1-3.	MS-ESS1.B	Analyzing and Interpreting Data	Scale, Proportion, and Quantity Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology	Mathematics: MP.4 6.RP.A.3

SOLAR SYSTEM AND BEYOND (continued)

Activity Description	Disciplinary Core Ideas	Science and Engineering Practices	Crosscutting Concepts	Common Core State Standards
14. **Investigation: Gravitational Force** Students are introduced to the concept of gravity. To understand what gravity is, students are given data sets relating the gravitational force to the mass of two objects and the distance between two objects. Students look for patterns in the data. From this investigation, students analyze and interpret data to determine that the more massive two objects are or the closer two objects are, the larger the gravitational force between them.	MS-ESS1.B	Analyzing and Interpreting Data	Patterns Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	Mathematics: 6.RP.A.3 6.SP.B.5
15. **Reading: The Effects of Gravity** Students are introduced to the concept that the objects in our Solar System orbit the Sun due to the gravitational interaction between each of the objects and the Sun. Students read about how gravity was responsible for the formation of our Solar System and Galaxy.	MS-ESS1.A MS-ESS1.B MS-PS2.A MS-PS2.B	Developing and Using Models	Systems and System Models Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	ELA/Literacy: RST.6-8.1 WHST.6-8.2
16. **Computer Simulation: Modeling Gravity** This activity has students use a computer simulation to observe how gravity is responsible for the motions within our Solar System. By modifying the distance between objects and the mass of objects, students are able to observe how these variables affect the orbital periods of planets in our Solar System. Extending this concept, students are able to calculate the mass of the Sun. Students are then asked to develop and use a model to describe the role of gravity in the motions within galaxies and solar systems. This activity provides an opportunity to assess Performance Expectation MS-ESS1-2.	MS-ESS1.A MS-ESS1.B	Developing and Using Models	Systems and System Models Connections to Nature of Science: Science Knowledge Assumes an Order and Consistency in Natural Systems	Mathematics: MP.2 MP.4 6.RP.A.3
17. **Talking it Over: Choosing a Mission** In this culminating activity, students are tasked with determining which space mission to Titan should be funded as a future NASA endeavor. Students weigh the trade-offs between the new technology that might result from a mission and the amount of potential data and information that can be collected. This activity helps students understand how space missions are chosen and what type of information is still being learned about our Solar System.	MS-ESS1.B	Analyzing and Interpreting Data	Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology:	ELA/Literacy: WHST.6-8.2 WHST.6-8.9 SL.8.4 SL.8.5