SUBJECT: SCIENCE/Earth and Space Science

BOE APPROVAL: August 2016

Cliffside Park Public Schools

GRADE: 6

Unit 6: Astronomy

CONTENT AREA: Earth Science	GRADES: 6	UNIT: 6 of 7
Pacing: Approx. 25 Days		

Science & Engineering Practices

• Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2)
Analyzing and Interpreting Data

• Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)
Developing and Using Models
Planning and Carrying Out Investigations

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

Develop and use a model to describe phenomena.

Disciplinary Core Ideas

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. (MS-ESS1-1)

• Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)

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. (MS-ESS1-2),(MS-ESS1-3)

• 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)

• The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)

Crosscutting Concepts

Patterns

• Patterns can be used to identify cause-and effect relationships. (MS-ESS1-1)

Scale, Proportion, and Quantity

• Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3)

Systems and System Models

• Models can be used to represent systems and their interactions. (MS-ESS1-2)

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Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology

• Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the

		development of entire industries and engineered systems. (MS-ESS1-3) - **Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems** **• Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1),(MS-ESS1-2)**

Performance Expectations: ESS1-1, ESS1-2, ESS1-3

Evidence Statement(s): ESS1-1, ESS1-2, ESS1-3

Essential Question: What are the scale properties of objects in the solar system?, What is the role of gravity in the motions within galaxies and the solar system?, What pattern in the Earth–sun–moon system can be used to explain lunar phases, eclipses of the sun and moon, and seasons?

21st Century Skills: **8.1.8.A.1, 8.1.8.A.2, 8.1.8.A.3, 8.1.8.A.4, 8.1.8.A.5, 8.1.8.D.4, 8.1.8.D.5**

Career Ready Practices: **CRP2, CRP4, CRP5, CRP6, CRP7, CRP8, CRP11,CRP12**

Technical Terms (Suggested)	Core Instructional Materials	Assessment Statement
The terms are located in the corresponding chapter of the students text. All terms will be addressed before the beginning of the unit.	MS-ESS1-1 - Chromebook, internet access, smartboard, notebook, pen, pencil, whiteboard. MS-ESS1-2- Computer, Internet access, smartboard, notebook, pen, pencil, whiteboard.	Students who understand the concepts are able to: • Students will develop and use a physical, graphical, or conceptual model to describe patterns in the apparent motion of the sun, moon, and stars in the sky.

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** All terms should be taught in context rather than in isolation. These terms should be addressed after conceptual understanding.**	MS-ESS1-3- Computer, Internet access, smartboard, notebook, pen, pencil, whiteboard.	Students who understand the concepts are able to: • Students develop and use models to explain the relationship between the tilt of Earth's axis and seasons. • Students who understand the concepts are able to: • Analyze and interpret data to determine similarities and differences among objects in the solar system.

Modifications

English Language Learners	Special Education	At Risk	Gifted & Talented
Scaffolding	Word walls	Teacher tutoring	Curriculum compacting
Word walls	Visual aides	Peer tutoring	Challenge assignments
Sentence/paragraph frames	Graphic organizers	Study guides	Enrichment activities
Bilingual dictionaries/translation	Multimedia	Graphic organizers	Tiered activities
Think alouds	Leveled readers	Extended time	Independent research/inquiry
Read alouds	Assistive technology	Parent communication	Collaborative teamwork
Highlight key vocabulary	Notes/summaries	Modified assignments	Higher level questioning
Annotation guides	Extended time	Counseling	Critical/Analytical thinking tasks
Think-pair-share	Answer masking		Self-directed activities
Visual aides	Answer eliminator		
Modeling	Highlighter		
Cognates	Color contrast		

Connections to other DCIs in this grade-band: MS.PS2.A ; MS.PS2.B

Articulation of DCIs across grade-bands: 3.PS2.A ; 5.PS2.B ; 5.ESS1.B ; HS.PS2.A ; HS.PS2.B ; HS.ESS1.B

5E Model	
Performance Expectation: MS-ESS1-1 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.	
Engage: Anticipatory Set	Begin by having students view the following video series: http://www.visuallearningsys.com/digital-science/preview. This series will provide students with an introduction to the Earth-sun-moon system by discussing the following topics: Planet Earth, Earth in Space, The Sun, Earth's Moon, Phases of the Moon, Eclipses and Tides. Provide students with the worksheet Video Review from the following learning guide to complete as they watch the video series (pg. 18). http://s3.amazonaws.com/VLCmedia/Digital_Science_Preview/Guide/Exploring_Earth_Sun_and_Moon_Guide.pdf. Following the videos, review the post-video questions from the Video Review worksheet as a class.
Exploration: Student Inquiry	To begin the lesson, have students view the following animations: These short animations provide visual representations of the following topics: Gravity, Lunar Eclipses, Phases of the Moon, Size of Earth to Sun, Size of Moon to Earth, Solar Eclipses and Tides. http://www.visuallearningsys.com/digital-science/preview Lab Activity: Moon Phases and Eclipses Use the following resources to guide students through a series of lab activities. http://www.myips.org/cms/lib8/IN01906626/Centricity/Domain/8123/Moon.pdf Lab Activity 1: What do You Think Causes the Phases of the Moon? Lab Activity 2: Modeling the Phases of the Moon Lab Activity 3: Determining which way the moon revolves around Earth Lab Activity 4: Synthesizing Your Understanding of the Phases of the Moon Lab Activity 5: Why Do We Always See the Same Side of the Moon? Lab Activity 6: What Causes Solar and Lunar Eclipses? Lab Activity 7: Why Don't We Have Solar and Lunar Eclipses Every Month?
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities.

	Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): 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 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.
Elaboration: Extension Activity	Phases of the Moon: In this activity, students will create a model to show how the regular motions of the Moon cause Moon phases. http://betterlesson.com/lesson/636034/phases-of-the-moon
Evaluation: Assessment	Assessment Task A: Post-Lab Refelction Questions (Activities 1-7) Assessment Task B: Model Evaluation & Reflection Develop and use a model to describe phenomena. Once students have made their models and reviewed them with the teacher, ask them to reflect on the accuracy of their model. Ask them to write a paragraph that compares the theory the developed in Lab Activity 1 to the actual arrangement of the sun, moon and Earth to create the phases of the moon, eclipses. and the seasons. What was similar? What was different? Were they surprised by the outcome? Did it bring up any questions? Ask students to hold a discussion with their partner before drafting the final paragraph.

5E Model	
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.	
Engage: Anticipatory Set	Gravity in the Solar System

Exploration: Student Inquiry	Students will make a 3D model of gravity. The following website provides a full lesson plan and explanation of procedures. Group students into small groups. Have the following supplies for each group: hula hoop, approx 1m2 (depends on size of hula hoop) of stretchy lycra material (or a garbage bags), Bulldog clips, a rock and three or four balls (marble, golf ball, ping pong ball) The Pull of the Planets Following the activity, each group will be assigned a common misconception about gravity. Students will use research material to explain the misconceptions. When Gravity Gets You Down
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): ESS1.A: The Universe and Its Stars Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. 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. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.
Elaboration: Extension Activity	
Evaluation: Assessment	Assessment Task A: Model Creation Develop and use a model to describe phenomena. Students will create models that conclude that based on the mass and distance of the object (planet, comet, astroid, meteoroid, etc...), the object's gravitational force is proportional. WIthin the explanation of the model, students will conclude that the orbital motion is caused by gravity. Develop a rubric to assess the above criteria.

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5E Model	
Performance Expectation: MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.	
Engage: Anticipatory Set	Begin lesson by asking students to draw a diagram of the solar system in and label all items. Remind students that they can use only one sheet of paper. Have students walk around the room and look at each other's diagrams. Have them discuss what they noticed about each other's diagrams. If you have access to a document camera you can use this to share the diagrams. Guide the discussion to focus on the size and distance of objects.
Exploration: Student Inquiry	Explain that all the images we know of the solar system are not to scale. In order to create a true model of the solar system, a much bigger is needed. Have students view the video: A Scale Model of the Solar System http://digg.com/video/scale-model-solar-system Distance Between Objects http://joshworth.com/dev/pixelspace/pixelspace_solarsystem.html Create a worksheet or chart on which student will record the distance from the sun for each planet. After completing the worksheet, create questions which require the student to analyze and interpret the data they recorded on the distance between these solar system objects. Size and Distance Comparison http://education.nationalgeographic.com/activity/planetary-size-and-distance-comparison/ Culminating Activity After having viewed and analyzed the data presented in these resources, have students work independently to summarize, in writing, what they learned about our solar system, including: - locations of planets in relation to the sun and one another - relative sizes of planets, including Earth - relative distances of planets - any conclusions they can draw about the locations of the asteroid belt and Kuiper belt
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices.

	Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): 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.
Elaboration: Extension Activity	Have student explore the following site: Build a Solar System Model. This website provides digital tools to determine accurate size and distance between the objects in our solar system, assisting students in creating an accurate model. http://www.exploratorium.edu/ronh/solar_system/
Evaluation: Assessment	Assessment Task A: Planetary Size Comparison Chart http://media.education.nationalgeographic.com/assets/file/Planetary_Size_Comparison_Worksheet.pdf Assessment Task B: Stepping Out in the Solar System http://media.education.nationalgeographic.com/assets/file/Stepping_Out_the_Solar_System_Worksheet.pdf Assessment Task C: Analysis & Interpretation of Data Analyze and interpret data to determine similarities and differences in findings. Have students work independently to summarize, in writing, what they learned about our solar system, including: - locations of planets in relation to the sun and one another - relative sizes of planets, including Earth - relative distances of planets - any conclusions they can draw about the locations of the asteroid belt and Kuiper belt

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This unit is broken down into three sub-ideas: the universe and its stars, Earth and the solar system, and the history of planet Earth. Students examine the Earth's place in relation to the solar system, the Milky Way galaxy, and the universe. There is a strong emphasis on a systems approach and using models of the solar system to explain the cyclical patterns of eclipses, tides, and seasons. There is also a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories explaining the formation and evolution of the universe. Students examine geosciences data in order to understand the processes and events in Earth's history. The crosscutting concepts of patterns, scale, proportion, and quantity and systems and systems models provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models and analyzing and interpreting data. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on MS-ESS1-1, MS-ESS1-2, and MS-ESS1-3.

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING PEs and DCIs
1	**Generate and analyze evidence (through simulations or long term investigations) to explain why the Sun's apparent motion across the sky changes over the course of a year. (ESS1.B)**	ESS1-1
2	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. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.] (MS-ESS1-1)	ESS1-1
3	**Develop and use a model that shows how gravity causes smaller objects to orbit around larger objects at increasing scales, including the gravitational force of the sun causes the planets and other bodies to orbit around it holding together the solar system. (ESS1.A; ESS1.B)**	ESS1-1
4	**Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: Emphasis is on the analysis of data from Earth based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.] (MS-ESS1-3)**	ESS1-3
5	**Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy**	ESS1-2

	of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.] (MS-ESS1-2)	

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.	**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** 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. **ESS1.A: The Universe and Its Stars** Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **ESS1.B: Earth and the Solar System**	**Influence of Science, Engineering, and Technology on Society and the Natural World** **All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.** **Patterns**

Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.	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. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.	**Patterns can be used to identify cause-and-effect relationships.** **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** **Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.** **Systems and System Models** **Models can be used to represent systems and their interactions.** **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

		Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. **Scale, Proportion, and Quantity** **Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.** **Connections to Engineering,Technology, and Applications of Science** **Interdependence of Science, Engineering, and Technology** **Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems.**

Connections to other DCIs in this grade-band: MS.PS2.A ; MS.PS2.B
Articulation of DCIs across grade-bands: 3.PS2.A ; 5.PS2.B ; 5.ESS1.B ; HS.PS2.A ; HS.PS2.B ; HS.ESS1.B
Common Core State Standards Connections: *ELA/Literacy - Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3) RST.6-8.1 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3) RST.6-8.7 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS1-1),(MS-ESS1-2) SL.8.5*

Mathematics - Reason abstractly and quantitatively. (MS-ESS1-3) MP.2 Model with mathematics. (MS-ESS1-1),(MS-ESS1-2) MP.4 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3) 6.RP.A.1 Recognize and represent proportional relationships between quantities. (MSESS1-1),(MS-ESS1-2),(MS-ESS1-3) 7.RP.A.2 Use variables to represent numbers and write expressions when solving a real world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-2) 6.EE.B.6 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-2) 7.EE.B.6