NGSS Grade 8: Unit 2 Sequencing

Noncontact forces influence phenomena locally and in the solar system.

PEs Assessed: ESS1-1 (moon phases)**, ESS1-2, ESS1-3, PS2-3, PS2-4, PS2-5, PS 3-2 (continued from unit 1)**

Sequence Developed by TUSD Teachers, April 2016

DCIs	**PS3.A Definitions of Energy** A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) **PS3.C: Relationship Between Energy and Forces** When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) (Continued from Unit 1)	**PS2.B: Types of Interactions** Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)	**PS2.B: Types of Interactions** Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)	**PS2.B: Types of Interactions** Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)	**ESS1.B: Earth and the Solar System** The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) **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. (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)	**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) **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. (MS-ESS1-1)
Additional Concepts	-kinetic -potential -force -transfer of energy	-forces at a distance: electric & magnetic -fields -space -movement through space	-magnet -compass -electricity -electrons -magnetic field -positive/negative -circuits?	-acceleration -mass -attraction	-Big Bang -inertia -galaxy -universe -gravitation pull on planets and space objects	-planets -moons -asteroids -comets	-elliptical -phases -eclipses -pattern -length of day, month, year -seasons -speed - orbit -distance -heliocentric - rotation
SEPs	**Developing and Using Models** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ☐ Develop a model to describe unobservable mechanisms. (MS-PS3-2)	**Asking Questions and Defining Problems** Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ☐ Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)	**Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ☐ -☐ Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5)	**Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds from 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. ☐ Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4) **Scientific Knowledge is Based on Empirical Evidence** ☐ Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-4)	**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 and use a model to describe phenomena. ((MS-ESS1-2)	**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. (MS-ESS1-3) **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 and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2)	**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 and use a model to describe phenomena. (MS-ESS1-1)
CCCs	**Systems and System Models** ☐ Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)	**Cause and Effect** ☐ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2- 5)	**Cause and Effect** ☐ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2- 5)	**Systems and System Models** ☐ Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-4),	**Systems and System Models** ☐ Models can be used to represent systems and their interactions. (MS-ESS1-2)	**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) **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. (MSESS1-3)	**Patterns** ☐ Patterns can be used to identify causeand-effect relationships. (MS-ESS1-1) **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)
PEs (boundaries of PE)	**Modeling Potential Energy** **MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.] Activity Brainstorm ● Perform ball drop inquiry lab ● Model results	**Noncontact Forces Investigations** **MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.] **MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.] Activity Brainstorm ● Electric tape http://www.phys.hawaii.edu/ams02/outreach/em_scotch.php ● Magnets http://my.execpc.com/~rhoadley/magindex.htm ● Homemade compass http://www.stevespanglerscience.com/lab/experiments/homemade-compass/ ● Electromagnetic experiments similar to ● http://www.hometrainingtools.com/a/electromagnetism-science-project		**Gravitational Interactions Simulation** **MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.] Activity Brainstorm ● Students interact with simulations and take notes/answer questions about gravitational interactions between objects ● Students create a google slideshow or use other media to present their evidence support PE ○ Sample simulations: http://www.physicsclassroom.com/Physics-Interactives/Circular-and-Satellite-Motion/Orbital-Motion, ○ https://phet.colorado.edu/en/simulation/legacy/gravity-and-orbits	**Modeling Gravitational Pull** **MS-ESS1-2. 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 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.] Activity Brainstorm ● Students create a model of how gravity affects systems within the universe: ○ holds together the solar system ○ Moons and other satellite orbits ○ Planetary motion ● Models can be posters or digital products that represent gravity in the systems listed above.	**Planetary Research Project** **MS-ESS1-3. 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.] Activity Brainstorm: ● Students conduct a research project on different planets to share properties of each planet and their surface features and orbital radius ● Students then compare two or more planets using student presentations	**Modeling Phases of the Moon** **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.** [Clarification Statement: Examples of models can be physical, graphical, or conceptual.] Activity Brainstorm ● Use model from vignette in CA framework