SUBJECT: SCIENCE/Life Science

BOE APPROVAL: August 2016

Cliffside Park Public Schools

GRADE: 6

Unit 5: Types of Interactions

CONTENT AREA: General Physical Science	GRADES: 6	UNIT: 5 of 7
Pacing: Approx. 1 Month (January)		

Science and Engineering Practices

Using Mathematics and Computational Thinking

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-4) Constructing Explanations and Designing Solutions
- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3) Planning and Carrying Out Investigations
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5)

Disciplinary Core Ideas

PS2.B: Types of Interactions

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4)

PS2.A: Forces and Motion

- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by) Instructional Days: 25 9 changes in the momentum of objects outside the system. (HS-PS2-3)

ETS1.A: Defining and Delimiting an Engineering Problem

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary) (HS-PS2-3)

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over

Crosscutting Concepts

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4)

Cause and Effect

- Systems can be designed to cause a desired effect. (HS-PS2-3)
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-5)

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Connections to Nature of Science Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Theories and laws provide explanations in science. (HS-PS2-4)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-4)

	others (trade-offs) may be needed. (secondary HS-PS2-3) **PS2.B: Types of Interactions** **• Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-5)** **• Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-5)** **PS3.A: Definitions of Energy** **• "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary HS-PS2-5)**	

Performance Expectations: MS-PS2-5, MS-PS2-3, MS-PSS2-4

Evidence Statement(s): MS-PS2-5, MS-PS2-3, MS-PSS2-4

Essential Question: Is it possible to exert on an object without touching it?

21st Century Skills: CRP2, CRP4, CRP5, CRP 6, CRP7, CRP8 ,CRP11,CRP12

Career Ready Practices: 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

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. ** All terms should be taught in context rather than in isolation. These terms should be addressed after conceptual understanding.**	MS-PS2-5,3,4 - Chromebook, internet access, smartboard, notebook, pen, pencil, whiteboard.	Students who understand the concepts are able to: • Students will conduct an investigation and evaluate an experimental design to produce data that can serve as the basis for evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. • Students will identify the cause-and-effect relationships between fields that exist between objects and the behavior of the objects.

		• Students will ask questions about data to determine the effect of the strength of electric and magnetic forces 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. • Students will perform investigations using devices that use electromagnetic forces. • Students will collect and analyze data that 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. •Students construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. • Students use models to represent the gravitational interactions between two masses.

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		

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5E Model	
Performance Expectation: MS-PS2-5 MS. Motion and Stability: Forces and Interactions **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.**	
Engage: Anticipatory Set	Force: Definitions and Types- Video and Quiz http://study.com/academy/lesson/force-definition-and-types.html
Exploration: Student Inquiry	Endangered Species- A Multiday Measurement: Forces In this lesson, students. will explore the idea that forces happen every time objects interact and will learn how these invisible pushed and pulls can be measured. http://betterlesson.com/lesson/637564/measurement-forces Exploring Magnetic Fields This lesson will reinforce the concept that magnets attract and repel items and exert a magnetic field that can vary in strength. http://sciencenetlinks.com/lessons/exploring-magnetic-fields/
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): 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).
Elaboration: Extension Activity	Exploring Magnetic Exploration In this activity, students will experience the magic of magnetics while exploring a futuristic transportation modality. http://betterlesson.com/lesson/601238/exploring-magnetic-levitation
Evaluation: Assessment	Assessment Task A:

5E Model

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Performance Expectation: MS-PS2-3

Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Engage: Anticipatory Set	Use these short video clips to explain magnetism, magnetic forces, electric currents, and motors. Magnetism http://www.neok12.com/video/Magnetism/zX4752067171765e67545d45.htm Try the experiment to view the magnetic field lines seen on the video. You will need white paper, iron filings, and several different magnets for each group. Make sure to record your findings and to draw pictures of what you observe in your science notebooks! View the How does electricity create a magnet video clip (4:57 minutes) at http://www.neok12.com/video/Magnetism/zX57555a4f5f0b606e625063.htm Try to create your own electromagnet as described in the video. You will need 20-30 staples, a piece of paper, a length of fine copper wire, and several batteries for each group. Make sure to record your data and findings and to draw pictures of what you observe in your science notebooks! So, How do motors work? The transformation of electrical energy to mechanical energy is best seen in a short video such as NeoK12's 2:20 minute video about How to build a simple motor, and how it works at http://www.neok12.com/php/watch.php?v=zX5b4c696f007c5c7d525a6b&t=How-It-Works Put the Charge in the Goal To Explore electric fields and electric charges, students will utilize the following interactive. This interactive challenges students to put the electron into the goal using positive and negative charges. http://www.physicsclassroom.com/Physics-Interactives/Static-Electricity/Put-the-Charge-in-the-Goal
Exploration: Student Inquiry	Electromagnets In this activity, students will make an electromagnet and evaluate how the stregnth of the electromagnet can be changed. http://betterlesson.com/lesson/637179/electromagnets
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): 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.
Elaboration: Extension Activity	Related Activities: MS-PS2-3 http://www.ck12.org/ngss/middle-school-physical-sciences/motion-and-stability:-forces-and-interactions
Evaluation: Assessment	Assessment Task A: Electromagnets, Students in Action (activity guide and summary). Students should be assessed based upon the quality of their questions and ability for frame a hypothesis based on observations and scientific principles. 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.

5E Model	
Performance Expectation: 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.	
Engage: Anticipatory Set	Ask students "How would life be different without gravity?" Students should record their thoughts first in their notebooks. Class should then hold a discussion sharing ideas in how they lives would be different and what adjustments they would need to be make. All ideas should be recorded on a large piece of posterboard/paper
Exploration: Student Inquiry	Super Planet Crash http://www.stefanom.org/spc/ To beat Planet Crash, students must create a planetary system that can survive for 500 years. Students will play 5 rounds. Students should observe that the closer the object is to the Sun the quicker the object moves and the larger the mass the more interference happens on the rest of the solar system. (Hint: Have your students at least in one of their rounds add the very massive Dwarf star.) Gravity and Orbits Lab https://phet.colorado.edu/en/simulation/gravity-and-orbits

	The two labs investigate how the force of gravity depends on mass as well as that the planets would continually move in a straight line due to inertia if the Sun suddenly disappeared. The labs also illustrate that the farther away the two planets are the longer (more time it takes to revolve around the Sun" How Much Do I Weight on Different Planets? http://www.exploratorium.edu/ronh/weight/ Have students calculate their weight on different planets. Once students have calculated their weight ask students to answer, "If your weight is different on different planets, does your mass differ on those same planets?" Gravity Exploration http://sciencespot.net/Media/gravlab.pdf
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): 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.
Elaboration: Extension Activity	The Great Gravity Escape https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_mars/cub_mars_lesson04_activity1.xml
Evaluation: Assessment	Assessment task A: 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. Based upon the various exploration activities, students will construct and present an oral and written argument supported by evidence and scientific reasoning. Distribute the quick guide to a well developed paragraph document to help students craft their written argument. https://docs.google.com/document/d/1QKaULOTkKr4z0F6PHvTR41E44noNdP2NupnibESg2ss/pub

Is it possible to exert on an object without touching it?

Students use cause and effect; system and system models; and stability and change to understand ideas that explain why some materials are attracted to each other while others are not. Students apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students develop understandings that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are expected to consider the influence of science, engineering, and technology on society and the natural world. Students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, designing solutions, and engaging in argument. Students are also expected to use these practices to demonstrate understanding of the core ideas.

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This unit is based on MS-PS2-3, MS-PS2-4, and MS-PS2-5.

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING PEs and DCIs
1	**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 is limited to qualitative evidence for the existence of fields.] (MS-PS2-5)	PS2.5
2	**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.]	PS2.3
3	**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.]	PS2.4

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

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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.	**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).	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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. **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. **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	**ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary) **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. **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.	**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.

explanation or a model for a phenomenon or a solution to a problem. **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** **Science knowledge is based upon logical and conceptual connections between evidence and explanations.**		

Connections to other DCIs in this grade-band:

Articulation of DCIs across grade-bands:

3.PS2.B ; HS.PS2.B ; HS.PS3.A ; HS.PS3.B ; HS.PS3.C

Common Core State Standards Connections:

ELA/Literacy - ELA: RST.6-8.3, WHST.6-8.7

- *Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.(HS-PS2-5), (HS-PS2-3) WHST.11-12.7*
- *Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS2-5) WHST.11-12.8*
- *Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-5) WHST.11-12.9*

Mathematics -

- Use units as a way to understand problems and to guide the solution of multi step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-5),(HS-PS2- 4) HSN.Q.A.1
- Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2- 5),(HS-PS2-4) HSN.Q.A.2
- Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-5),(HS-PS2-4) HSN.Q.A.3
- Reason abstractly and quantitatively. (HS-PS2-4) MP.2
- Model with mathematics. (HS-PS2-4) MP.4
- Interpret expressions that represent a quantity in terms of its context. (HS-PS2-4) HSA.SSE.A.1
- Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-4) HSA.SSE.B.3