Rochelle Park School District

Curriculum Guide

Science
Grade 8

BOE Approved on August 30, 2022

Unit 1: Overview
Unit 1: Interactions of Matter
Grade: 8
Content Area: Physical Science
Pacing: 20 Instructional Days
Essential Question
How can we trace synthetic materials back to natural ingredients?
Student Learning Objectives (Performance Expectations)
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
Unit Summary
Students build understandings of what occurs at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They also provide molecular level accounts to explain states of matter and changes between states. The crosscutting concepts of cause and effect, scale, proportion and quantity, structure and function, interdependence of science, engineering, and technology, and the influence of science, engineering and technology on society and the natural world provide a framework for understanding the disciplinary core ideas. Students demonstrate grade appropriate proficiency in developing and using models, and obtaining, evaluating, and communicating information. Students are also expected to use the scientific and engineering practices to demonstrate understanding of the core ideas.
Technical Terms
Molecular level, thermal energy, radiation, conduction, thermal conductor, thermal insulator, specific heat, thermal contraction, thermal expansion
Formative Assessment Measures
Part A: How can you tell what the molecules are doing in a substance?
Students who understand the concepts are able to: Develop a model that predicts and describes changes in particle motion that could include molecules or inert atoms or pure substances. Use cause-and-effect relationships to predict changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural or designed systems.
Part B: How can we trace synthetic materials back to natural ingredients?
Students who understand the concepts are able to:

<table>
<tr><td colspan="3">Obtain, evaluate, and communicate information to show that synthetic materials come from natural resources and affect society.
Gather, read, and synthesize information about how synthetic materials formed from natural resources affect society.
Assess the credibility, accuracy, and possible bias of each publication and methods used within the publication.
Describe how information about how synthetic materials formed from natural resources affect society is supported or not supported by evidence.</td></tr>
<tr><th colspan="3">Interdisciplinary Connections</th></tr>
<tr><th colspan="2">NJSLS- ELA</th><th>NJSLS- Mathematics</th></tr>
<tr><td colspan="2">Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS1-3)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-PS1-4)RST.6-8.7
Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3) WHST.6-8.8</td><td>Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4) 6.NS.C.5</td></tr>
<tr><td>Core Instructional Materials</td><td colspan="2">Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.</td></tr>
<tr><td>Career Readiness, Life Literacies and Key Skills</td><td colspan="2">9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
9.4.8.CI.2: Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).
9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2).
9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries.</td></tr>
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	9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2). 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1). 9.4.8.CT.3: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome. 9.4.8.DC.1: Analyze the resource citations in online materials for proper use. 9.4.8.DC.2: Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8). 9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities). 9.4.8.GCA.2: Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal. 9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information. 9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations. 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data. 9.4.8.IML.7: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8). 9.4.8.IML.8: Apply deliberate and thoughtful search strategies to access high-quality information on climate change (e.g., 1.1.8.C1b) 9.4.8.IML.12: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience. 9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4). 9.4.8.TL.3: Select appropriate tools to organize and present information digitally. 9.4.8.TL.4: Synthesize and publish information about a local or global issue or event (e.g., MSLS4-5, 6.1.8.CivicsPI.3). 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
Computer Science and Design	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

Thinking	8.1.8.DA.6: Analyze climate change computational models and propose refinements. 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem. 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team. 8.2.8.ED.5: Explain the need for optimization in a design process. 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product. 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches). 8.2.8.ITH.2: Compare how technologies have influenced society over time. 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact. 8.2.8.ITH.5: Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another. 8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product. 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital). 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact. 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.

Modifications				
English Language Learners	**Special Education**	**At-Risk**	**Gifted and Talented**	**504**
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology

Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Modified assignments Counseling	Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE		
MS. Matter and Its Interactions		
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.		
Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.		
Assessment Boundary: Assessment is limited to qualitative information.		
Evidence Statements: MS-PS1-3		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new	**Structure and Function** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. **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. **Influence of Science, Engineering and Technology on Society and the Natural World** The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by

and methods used, and describe how they are supported or not supported by evidence.	substances have different properties from those of the reactants.	differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.
Connections to other DCIs in this grade-band: MS.LS2.A ; MS.LS4.D ; MS.ESS3.A ; MS.ESS3.C		
Articulation of DCIs across grade-bands: HS.PS1.A ; HS.LS2.A ; HS.LS4.D ; HS.ESS3.A		
NJSLS- ELA: RST.6-8.1, WHST.6-8.8		
NJSLS- Math: N/A		

5E Model	
MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	
Engage Anticipatory Set	Poster paper will be placed around the room. Each poster will have a natural resource as a title Trees, Oil, Soil, Natural Gas. Students will take post-its which includes common materials we use from Earth and place them under the natural resource posted associated with that the production of that material. Use the following graph: Common Materials We Use from Earth https://www.ck12.org/earth-science/Materials-Humans-Use/lesson/Materials-Humans-Use/?referrer=concept_details
Exploration Student Inquiry	Clothing Matters http://www.mineralseducationcoalition.org/pdfs/study/studyoftheearth.pdf https://www.ck12.org/earth-science/Materials-Humans-Use/
Explanation Concepts and 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): PS1.A: Structure and Properties of Matter Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) PS1.B: Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3)
Elaboration Extension Activity	Have students complete additional activities from the following unit: A Study of the Earth's- Natural Resources http://www.mineralseducationcoalition.org/pdfs/study/studyoftheearth.pdf

Evaluation Assessment Tasks	Assessment Task A Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. Students will synthesize the information learned in the lab. Use the following questions to guide the student's written response. Which materials are man-made and which are natural? Analyze the "content" and "care" information. Determine the characteristics of different clothing materials. Why can some be washed in hot water, others only in cold? Why can't some be put in a clothes dryer or ironed? What about bleach? What properties of ber make it attractive for clothing use? Analyze the "content" and "care" information. Determine the characteristics of different clothing materials. Why can some be washed in hot water, others only in cold? Why can't some be put in a clothes dryer or ironed? What about bleach? What effect, if any, does the availability of natural resources have on your life-style? Has the need for resources ever caused war? What causes famine in some countries? Is it lack of food or politics? Has the need for resources ever caused war? What causes famine in some countries? Is it lack of food or politics? Can a country maintain its independence and quality of life without a dependable supply of natural resources? If yes, for how long? If no, what can that country do to continue its existence? Is there anything that isn't made from a natural resource? Have groups of students challenge one another to research something that doesn't come from natural resources.

PHYSICAL SCIENCE
MS. Matter and Its Interactions
MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.
Assessment Boundary: N/A
Evidence Statements: MS-PS1-4

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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 predict and/or describe phenomena.	**PS1.A: Structure and Properties of Matter** Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **PS3.A: Definitions of Energy** The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary) The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary)	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Connections to other DCIs in this grade-band: MS.ESS2.C		
Articulation of DCIs across grade-bands: HS.PS1.A ; HS.PS1.B ; HS.PS3.A		

<table>
<tr><td colspan="2">NJSLS- ELA: RST.6-8.7</td></tr>
<tr><td colspan="2">NJSLS- Math: 6.NS.C.5</td></tr>
<tr><td colspan="2">5E Model</td></tr>
<tr><td colspan="2">MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.</td></tr>
<tr><td>Engage
Anticipatory Set</td><td>Introduction Video: States of Matter
http://betterlesson.com/lesson/639789/states-of-matter?from=search_lesson_title
https://www.youtube.com/watch?v=HAPc6JH85pM</td></tr>
<tr><td>Exploration
Student Inquiry</td><td>Crack that Marble Lab
http://betterlesson.com/lesson/634011/crack-that-marble-properties-of-matter-labs

Molecules in Motion (download the Lesson 1.2 PDF to access the lesson plan)
http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson2</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td>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):
PS1.A: Structure and Properties of Matter
Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide.
In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
PS3.A: Definitions of Energy
The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary)
The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal</td></tr>
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	energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary)
Elaboration Extension Activity	Determine the melting and freezing points of a substance. Analyze a phase change curve. Students will observe what happens as matter undergoes a phase change. Start with cetyl alcohol in the solid phase well below its melting point. Make observations as heat is added. Keep recording the temperature until the substance is totally melted. Reverse the process and let the same sample cool. (it will cool just sitting out at room temperature with the heat removed.) Explain the relationship between temperature and the energy associated with the motion of atoms. Write a hypothesis of what a graph of the temperature changes will look like. Students will graph the results of the temperature changes. A representative from each group will describe each part of the graph using their own words.
Evaluation Assessment Tasks	Assessment Task A: Draw a Model Activity Sheet Develop a model to predict and/or describe phenomena. Students will follow the steps outlined on the Student Activity Sheet. Students should be assessed based upon accuracy of model drawn and analysis of activity using a written response to the guiding questions.

Unit 2: Overview
[Unit 2: Types of Interactions]
Grade: 8
Content Area: Physical Science
Pacing: 25 Instructional Days
Essential Question
Is it possible to exert on an object without touching it?
Student Learning Objectives (Performance Expectations)
MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
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.
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.
Unit Summary
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.
Technical Terms
Gravitational forces, electrical forces, magnetic forces, attract, repel, attractive, negative, air resistance, centripetal acceleration, centripetal force, joule, kinetic energy, mechanical energy, electrical conductors, electrical insulators, semiconductors, superconductors, induction, polarization
Formative Assessment Measures
Part A: Can you apply a force on something without touching it?
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.
Part B: How does a Maglev train work?
Students who understand the concepts are able to:
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.
Part C: If I were able to eliminate air resistance and dropped a feather and a hammer at the same time, which would land first?
Students who understand the concepts are able to: 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.

Interdisciplinary Connections	
NJSLS- ELA	**NJSLS- Mathematics**
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	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

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	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

Core Instructional Materials	Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.
Career Readiness, Life Literacies and Key Skills	9.4.8.CI.2: Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3). 9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information. 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
Computer Science and Design Thinking	8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem. 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).

Modifications				
English Language Learners	**Special Education**	**At-Risk**	**Gifted and Talented**	**504**
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE		
MS. Motion and Stability: Forces and Interactions		
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.		
Evidence Statements: MS-PS2-3		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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.	**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.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Connections to other DCIs in this grade-band: N/A		
Articulation of DCIs across grade-bands: 3.PS2.B ; HS.PS2.B		
NJSLS- ELA: RST.6-8.1		
NJSLS- Math: MP.2		

5E MODEL	
MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.	
Engage	Use these short video clips to explain magnetism, magnetic forces, electric currents, and motors.

Anticipatory Set	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) 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: 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 strength of the electromagnet can be changed. http://betterlesson.com/lesson/637179/electromagnets
Explanation Concepts and 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 Tasks	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.

PHYSICAL SCIENCE		
MS. Motion and Stability: Forces and Interactions		
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 and Kepler's Laws.		
Evidence Statements: MS-PS2-4		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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. **Connections to Nature of Science**	**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.

<table>
<tr><td>Scientific Knowledge is Based on Empirical Evidence
Science knowledge is based upon logical and conceptual connections between evidence and explanations.</td><td></td><td></td></tr>
<tr><td colspan="3">Connections to other DCIs in this grade-band: MS.ESS1.A ; MS.ESS1.B ; MS.ESS2.C</td></tr>
<tr><td colspan="3">Articulation of DCIs across grade-bands: 5.PS2.B ; HS.PS2.B ; HS.ESS1.B</td></tr>
<tr><td colspan="3">NJSLS- ELA: WHST.6-8.1</td></tr>
<tr><td colspan="3">NJSLS- Math: N/A</td></tr>
<tr><td colspan="3">5E MODEL</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td>Engage
Anticipatory Set</td><td colspan="2">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</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="2">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/</td></tr>
</table>

	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, do es your mass differ on those same planets?" Gravity Exploration http://sciencespot.net/Media/gravlab.pdf
Explanation Concepts and 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 Tasks	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

PHYSICAL SCIENCE
MS. Motion and Stability: Forces and Interactions
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.		
Evidence Statements: MS-PS2-5		
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. 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.	**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.
Connections to other DCIs in this grade-band: N/A		
Articulation of DCIs across grade-bands: 3.PS2.B ; HS.PS2.B ; HS.PS3.A ; HS.PS3.B ; HS.PS3.C		
NJSLS- ELA: RST.6-8.3, WHST.6-8.7		
NJSLS- Math: N/A		

5E MODEL	
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.	
Engage Anticipatory Set	Force: Definitions and Types- Video and Quiz http://study.com/academy/lesson/force-definition-and-types.html
Exploration Student Inquiry	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
Explanation	In these lessons:

Concepts and Practices	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	Measurement: Mass Relearn Activity
Evaluation Assessment Tasks	Assessment Task A: Measurement Force Exploration Worksheet 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. Measurement Force Exploration As students collect data, make sure the data provides evidence that fields exist between objects exerting forces on each other even though the objects are not in contact

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Unit 3: Overview
[Unit 3: Structure and Properties of Matter]
Grade: 8
Content Area: Physical Science
Pacing: 20 Instructional Days
Essential Question
How is it that everything is made of stardust?
Student Learning Objectives (Performance Expectations)
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
Unit Summary
Students build understandings of what occurs at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They also provide a molecular level accounts to explain states of matter and changes between states. The crosscutting concepts of cause and effect, scale, proportion and quantity, structure and function, interdependence of science, engineering, and technology, and the influence of science, engineering and technology on society and the natural world provide a framework for understanding the disciplinary core ideas. Students demonstrate grade appropriate proficiency in developing and using models, and obtaining, evaluating, and communicating information. Students are also expected to use the scientific and engineering practices to demonstrate understanding of the core ideas.
Technical Terms
Electron Cloud model, atoms, molecule, subatomic, nucleus, proton, neutron, electron, particle, electron cloud, isotopes, transmutation, alpha particle, beta particle, atomic scale, molecular scale
Formative Assessment Measures
Part A: If the universe is not made of Legos®, then what is it made of?
Students who understand the concepts are able to: Develop a model of a simple molecule. Use the model of the simple molecule to describe its atomic composition. Develop a model of an extended structure. Use the model of the extended structure to describe its repeating subunits. *[Boundary: The substructure of atoms and the periodic table are learned in high school chemistry.]*
Part B: Is it possible to tell if two substances mixed or if they reacted with each other?
Students who understand the concepts are able to: Analyze and interpret data to determine similarities and differences from results of chemical reactions between substances before and after they

undergo a chemical process. Analyze and interpret data on the properties of substances before and after they undergo a chemical process. Identify and describe possible correlation and causation relationships evidenced in chemical reactions. Make logical and conceptual connections between evidence that chemical reactions have occurred and explanations of the properties of substances before and after they undergo a chemical process.		
Interdisciplinary Connections		
NJSLS- ELA		**NJSLS- Mathematics**
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.(MS-PS1-2)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-PS1-1),(MS-PS1-2) RST.6-8.7		Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2) MP.2 Model with mathematics. (MS-PS1-1) MP.4 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1),(MS-PS1-2) 6.RP.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1) 8.EE.A.3 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2) 6.SP.B.4 Summarize numerical data sets in relation to their context. (MS-PS1-2) 6.SP.B.5
Core Instructional Materials	Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.	
Career Readiness, Life Literacies and Key Skills	9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4). 9.4.8.CI.2: Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3). 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2). 9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries. 9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2). 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1). 9.4.8.CT.3: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.	

	9.4.8.DC.1: Analyze the resource citations in online materials for proper use. 9.4.8.DC.2: Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8). 9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities). 9.4.8.GCA.2: Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal. 9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information. 9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations. 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data. 9.4.8.IML.7: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8). 9.4.8.IML.8: Apply deliberate and thoughtful search strategies to access high-quality information on climate change (e.g., 1.1.8.C1b) 9.4.8.IML.12: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience. 9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4). 9.4.8.TL.3: Select appropriate tools to organize and present information digitally. 9.4.8.TL.4: Synthesize and publish information about a local or global issue or event (e.g., MSLS4-5, 6.1.8.CivicsPI.3). 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem. 9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
Computer Science and Design Thinking	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.6: Analyze climate change computational models and propose refinements. 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.

	8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team. 8.2.8.ED.5: Explain the need for optimization in a design process. 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product. 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches). 8.2.8.ITH.2: Compare how technologies have influenced society over time. 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact. 8.2.8.ITH.5: Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another. 8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product. 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital). 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact. 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.

Modifications				
English Language Learners	**Special Education**	**At-Risk**	**Gifted and Talented**	**504**
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time

Annotation guides Think-pair- share Visual aides Modeling Cognates	Answer masking Answer eliminator Highlighter Color contrast		Critical/Analytical thinking tasks Self-directed activities	Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE		
MS. Matter and Its Interactions		
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.		
Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.		
Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.		
Evidence Statements: MS-PS1-1		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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 predict and/or describe phenomena.	**PS1.A: Structure and Properties of Matter** Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	**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 other DCIs in this grade-band: MS.ESS2.C		
Articulation of DCIs across grade-bands: 5.PS1.A ; HS.PS1.A ; HS.ESS1.A		

NJSLS- ELA: RST.6-8.7	
NJSLS- Math: MP.2, MP.4, 6.RP.A.3, 8.EE.A.3	
5E Model	
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.	
Engage Anticipatory Set	What is an Atom? To introduce this topic, have students view the following video. This video will provide a basic introduction into structure of atoms and molecules. http://www.makemegenius.com/science-videos/grade_7/all-about-atoms-and-molecules-for-kids
Exploration Student Inquiry	Have the students work in groups. Each group will be given a different simple molecule. Ex: ammonia, methanol. Research their molecule, find out its composition, identify the type of bond, and uses of the compound. Marshmallow Molecules http://betterlesson.com/lesson/634009/marshmallow-molecules Digital Models: https://phet.colorado.edu/en/simulation/build-a-molecule Research the molecular structure of ammonia and methanol. Using PowerPoint, work in a group to create a digital model of these simple molecules structures.
Explanation Concepts and 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): PS1.A: Structure and Properties of Matter Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
Elaboration Extension Activity	Have students create a digital model of a complex, extended structure. Some extended structures the students' research can include: Diamonds, Sugar, Nylon. https://phet.colorado.edu/en/simulation/build-a-molecule
Evaluation Assessment Tasks	Assessment Task A Students will work in groups to develop a model using a digital presentation method (Powerpoint, Google Slides, Prezi, etc...) The models must describe the atomic composition of simple molecules and extended structures.

	Develop a model to predict and/or describe phenomena.

PHYSICAL SCIENCE		
MS. Matter and Its Interactions		
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.		
Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.		
Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.		
Evidence Statements: MS-PS1-2		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 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. **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.	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	**Patterns** Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
Connections to other DCIs in this grade-band: MS.PS3.D ; MS.LS1.C ; MS.ESS2.A		
Articulation of DCIs across grade-bands: N/		
CCSS- ELA: RST.6-8.1, RST.6-8.7		
CCSS- Math: MP.2, 6.RP.A.3, 6.SP.B.4, 6.SP.B.5		
5E Model		

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	
Engage Anticipatory Set	Amazing Chemical Reactions: https://www.youtube.com/watch?v=FofPjj7v414 http://betterlesson.com/lesson/634016/chemical-reactions-un-notes
Exploration Student Inquiry	http://www.education.com/science-fair/article/balloon-gas-chemical-reaction/ Students are placed in small groups, and given samples of baking soda and white vinegar. In their groups, they must observe and classify each substance's individual physical properties. Using a graphic organizer, a list of each substance's properties will be collaboratively developed. After the initial investigation, one representative from each student group will share their group's list of physical properties with the whole class. During this time, students from different groups can record additional properties or correct mislabeled properties. The teacher will then briefly explain the exploration activity and appropriate safety procedures to students. Prior to the exploration activity, the teacher may ask the following guiding questions to engage students: · What do you think will happen when baking soda and vinegar come in contact (what will be produced)? · What do you think will happen to the balloon attached? Using the funnel, each student group will add 2 tablespoons of baking soda to each balloon (two people may be needed for this; one person to hold the balloon open and the other person to put the baking soda inside of the balloon). Then the group will pour 4 ounces of vinegar into the bottle. Students will carefully fit the balloon over the bottle opening, and be careful not to drop the baking soda into the vinegar yet. Once the balloon is fitted snugly on the nozzle, students will hold up the balloon and allow the baking soda to fall into the vinegar. Students will observe the chemical reaction and effect on the balloon and record observations/data/visuals in their science journals. Students will respond to the following prompts in their science journals following this exploration activity in words and using pictorial representations: · Which two substances combined? · What happened when the two substances combined? How do you know? · What was formed as a product of the reaction? Explain your reasoning. · Why is this a chemical reaction? Use evidence to support your thinking.
Explanation Concepts and 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):

	PS1.A: Structure and Properties of Matter Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) PS1.B: Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2)
Elaboration Extension Activity	Student groups will reassemble and follow the same procedure from the exploration activity. However, the vinegar component will be replaced with a “mystery substance”. Each group will receive a different mystery substance (water, hydrogen peroxide) to combine with the baking soda. Following the experiment, students will have to determine whether or not a chemical reaction took place. If time permits, each group of students will research (using online resources) a career in the field of Chemistry in pursuit of the following information: · Briefly describe the purpose of this job. · What are some specific tasks? · What kind of education and experience is required? · Describe the kinds of places that people with this job might work. (For example, in a lab, outside, or in an office?) · In what types of companies do people with this job work? Using this research as a guide, each individual student of the group will create a narrative piece describing a day in the life of a person with that particular profession.
Evaluation Assessment Tasks	Assessment Task A: Analysis & Interpretation of Data Analyze and interpret data to determine similarities and differences in findings. Have students work independently to summarize, in writing, if a chemical reaction has occurred. Students should include evidence based upon observations from exploration activity.

Unit 4: Overview
Unit 4: Relationships Among Forms of Energy
Grade: 8
Content Area: Physical Science
Pacing: 20 Instructional Days
Essential Question
How can physics explain sports?
Student Learning Objectives (Performance Expectations)
MS.PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
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.
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
Unit Summary
In this unit, students use the practices of analyzing and interpreting data, developing and using models, and engaging in argument from evidence to make sense of relationship between energy and forces. Students develop their understanding of important qualitative ideas about the conservation of energy. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students also understand the difference between energy and temperature, and the relationship between forces and energy. The crosscutting concepts of scale, proportion, and quantity, systems and system models, and energy and matter are called out as organizing concepts for these disciplinary core ideas. Students use the practices of analyzing and interpreting data, developing and using models, and engaging in argument from evidence.Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Kinetic energy, potential energy, electric interactions, magnetic interaction, gravitational interactions, empirical evidence
Formative Assessment Measures
Part A: Is it better to have an aluminum (baseball/softball) bat or a wooden bat?
Students who understand the concepts are able to: Construct and interpret graphical displays of data to identify linear and nonlinear relationships of kinetic energy to the mass of an object and to the speed of an object.
Part B: What would give you a better chance of winning a bowling match, using a basketball that you can roll really fast, or a bowling ball that you can only roll slowly?
Students who understand the concepts are able to:

Develop a model to describe what happens to the amount of potential energy stored in the system when the arrangement of objects interacting at a distance changes Use models to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. Models could include representations, diagrams, pictures, and written descriptions.		
Part C: Who can design the best roller coaster?		
<u>Students who understand the concepts are able to:</u> Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. Conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. Do not include calculations of energy.		
Interdisciplinary Connections		
NJSLS- ELA		**NJSLS- Mathematics**
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS3-1),(MS-PS3-5) 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-PS3-1) RST.6-8.7 Write arguments focused on discipline content. (MS-PS3-5) WHST.6-8.1 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS3-3) WHST.6-8.7 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2) SL.8.5		Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-5) MP.2 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),(MS-PS3-5) 6.RP.A.1 Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. (MS-PS3-1) 6.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-PS3-1),(MS-PS3-5) 7.RP.A.2 Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1) 8.EE.A.1 Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. (MS-PS3-1) 8.EE.A.2 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),(MS-PS3-5) 8.F.A.3
Core Instructional Materials	Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.	
Career Readiness, Life Literacies and Key Skills	9.4.8.IML.1 Critically curate multiple resources to assess the credibility of sources when searching for information. 9.4.8.IML Ask insightful questions to organize different types of data and create meaningful visualizations.	

	9.4.8.IML.12 Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience. 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem. 9.4.8.TL.3 Select appropriate tools to organize and present information digitally.
Computer Science and Design Thinking	8.1.8.DA.1 Organiza and transform data collected using computational tools to make it usable for a specific purpose. 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model. 8.2.8.ETW.2 Analyze the impact of modifying resources in a product or system. 8.1.8.AP.2Create clearly named variables that represent different data types and perform operations on their values.

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented	504
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE
MS. Energy
MS.PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.
Assessment Boundary: N/A

Evidence Statements: MS-PS3-1		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Construct and interpret graphical displays of data to identify linear and nonlinear relationships.	**PS3.A: Definitions of Energy** Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.	**Scale, Proportion, and Quantity** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
Connections to other DCIs in this grade-band: MS.PS2.A		
Articulation of DCIs across grade-bands: 4.PS3.B ; HS.PS3.A ; HS.PS3.B		
NJSLS- ELA: RST.6-8.1, RST.6-8.7		
NJSLS- Math: MP.2, 6.RP.A.2, 7.RP.A.2, 8.EE.A.1, 8.EE.A.2, 8.F.A.3		

5E MODEL	
MS.PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.	
Engage Anticipatory Set	Using the following resource, students will view videos, read articles and engage in interactive simulation s related to kinetic energy. http://www.ck12.org/ngss/middle-school-physical-sciences/energy
Exploration Student Inquiry	Kinetic and Potential Energy Lab Rotation In these lab activities, students will determine the relationship among the energy transferred, the type of matter, the mass and the change in the average kinetic energy of the particles. Students will construct and interpret graphical displays on their data dn construct, use, and present arguments to support a claim. http://betterlesson.com/lesson/640019/exploring-the-relationship-between-potential-kinetic-energy
Explanation	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities.

Concepts and Practices	Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): PS3.A: Definitions of Energy Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
Elaboration Extension Activity	Rubber Band Cannon Lab Students use rubber band cannons to explore potential and kinetic energy transfer! http://betterlesson.com/lesson/633996/rubber-band-cannon-lab
Evaluation Assessment Tasks	Assessment Task A Construct and interpret graphical displays of data to identify linear and nonlinear relationships. Students will construct and interpret graphical displays on their data and construct, use, and present arguments to support a claim. Complete Energy Skate Park Exploration Potential and Kinetic Energy activity guide.

PHYSICAL SCIENCE		
MS. 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.		
Evidence Statements: MS-PS3-2		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe,	**PS3.A: Definitions of Energy** A system of objects may also contain stored (potential) energy, depending on their relative positions.	**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.

test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms.	**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.	

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands: HS.PS2.B ; HS.PS3.B ; HS.PS3.C

NJSLS- ELA: SL.8.5

NJSLS- Math: N/A

5E MODEL

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.

Engage Anticipatory Set	Roller Coast Science: Video http://www.discovery.com/tv-shows/other-shows/videos/time-warp-roller-coaster-science/ Roller Coaster: Engineering and Construction http://www.sciencechannel.com/video-topics/engineering-construction/machines-rollercoaster/
Exploration Student Inquiry	Building Roller Coasters Students will work in pairs/groups to create a physical roller coaster. Refer to the following website for detailed instructions and student worksheets. https://www.teachengineering.org/view_activity.php?url=collection/duk_/activities/duk_rollercoaster_music_act/duk_rollercoaster_music_act.xml
Explanation Concepts and 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): PS3.A: Definitions of Energy A system of objects may also contain stored (potential) energy, depending on their relative positions. 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.
Elaboration Extension Activity	Hold discussion on why some roller coasters failed, show videos of X-games events involving energy transformations and motion. Students will be encouraged to participate in discussion about what they viewed and why certain X-games athletes were successful in certain tricks while others failed.
Evaluation Assessment Tasks	Assessment Task A Develop a model to describe unobservable mechanisms. Students will complete Roller Coaster worksheet.

PHYSICAL SCIENCE		
MS. Energy		
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.		
Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.		
Assessment Boundary: Assessment does not include calculations of energy.		
Evidence Statements: MS-PS3-5		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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 worlds. Construct, use, 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.	**PS3.B: Conservation of Energy and Energy Transfer** When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	**Energy and Matter** Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).

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: MS.PS2.A		
Articulation of DCIs across grade-bands: 4.PS3.C ; HS.PS3.A ; HS.PS3.B		
NJSLS- ELA: RST.6-8.1, WHST.6-8.1		
NJSLS- Math: MP.2, 6.RP.A.1, 7.RP.A.2, 8.F.A.3		

5E MODEL	
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	
Engage Anticipatory Set	Using the following resources have students view videos, read articles and engage in discussion on how kinetic energy changes, energy is transferred to or from objects. Go to the MS-PS3-5 section of the page. http://www.ck12.org/ngss/middle-school-physical-sciences/energy
Exploration Student Inquiry	Show students videos comparing crash tests on vehicles traveling at different speeds into different barriers and ask students to collaborate and show how energy transfers are occurring in the video. Energy Transfer: Engineering Catapults In this activity, students will describe and model situations in which different amounts of potential energy are stored in a system and support the claim that when the kinetic energy of an object changes, that energy that has been transferred to or from the objects in the system. http://betterlesson.com/lesson/633997/energy-transfer-engineering-catapults
Explanation Concepts and 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): PS3.B: Conservation of Energy and Energy Transfer

	When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
Elaboration Extension Activity	Egg Projectile Project http://www.ehow.com/how_8405300_do-egg-projectile-project.html
Evaluation Assessment Tasks	Assessment Task A Construct, use, 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. Students will complete Step 7 in the Energy Transfer Lab Activity. Using the Quick Guide to Creating a Well Developed Paragraph in Science, students will construct an argument supported by evidence.

Unit 5: Overview
Unit 5: Thermal Energy
Grade: 8
Content Area: Physical Science
Pacing: 30 Instructional Days
Essential Question
How can a standard thermometer be used to tell you how particles are behaving?
Student Learning Objectives (Performance Expectations)
MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
Unit Summary
In this unit, students ask questions, plan and carry out investigations, engage in argument from evidence, analyze and interpret data, construct explanations, define problems and design solutions as they make sense of the difference between energy and temperature. They use the practices to make sense of how the total change of energy in any system is always equal to the total energy transferred into or out of the system. The crosscutting concepts of energy and matter, scale, proportion, and quantity, and influence of science, engineering, and technology on society and the natural world are the organizing concepts for these disciplinary core ideas. Students ask questions, plan and carry out investigations, engage in argument from evidence, analyze and interpret data, construct explanations, define problems and design solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Thermal energy transfer, thermal dynamics, fahrenheit, kinetic energy, mass, potential energy, gravity , conduction , convection, radiation, calorimetry
Formative Assessment Measures

Part A: How can a standard thermometer be used to tell you how particles are behaving?
<u>Students who understand the concepts are able to:</u> Individually and collaboratively plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of particles as measured by the temperature of the sample. As part of a planned investigation, identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Make logical and conceptual connections between evidence and explanations.
Part B: You are an engineer working for NASA. In preparation for a manned space mission to the Moon, you are tasked with designing, constructing, and testing a device that will keep a hot beverage hot for the longest period of time. It costs approximately $10,000 per pound to take payload into orbit so the device must be lightweight and compact. The lack of atmosphere on the Moon produces temperature extremes that range from -157 degrees C in the dark to +121 degrees C in the light. Your devise must operate on either side of the Moon (https://spaceflightsystems.grc.nasa.gov/education/rocket/moon.html).
<u>Students who understand the concepts are able to:</u> Apply scientific ideas or principles to design, construct, and test a design of a device that either minimizes or maximizes thermal energy transfer. Determine design criteria and constraints for a device that either minimizes or maximizes thermal energy transfer. Test design solutions and modify them on the basis of the test results in order to improve them. Use a systematic process for evaluating solutions with respect to how well they meet criteria and constraints.

Interdisciplinary Connections	
NJSLS- ELA	**NJSLS- Mathematics**
Cite specific textual evidence to support analysis of science and technical texts. (MS-PS3-5),MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) RST.6-8.1 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4) RST.6-8.3 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-PS3-3),(MS-PS3-4),(MS-ETS1-3) RST.6-8.7	Reason abstractly and quantitatively. (MS-PS3-4),(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4) MP.2 Summarize numerical data sets in relation to their context. (MS-PS3-4) 6.SP.B.5 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) 7.EE.3

Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) RST.6-8.9 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2) WHST.6-8.7 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) WHST.6-8.8 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) WHST.6-8.9 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4) SL.8.5	Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4) 7.SP

Core Instructional Materials	Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.
Career Readiness, Life Literacies and Key Skills	9.4.8.CI.2 Repurpose an existing resource in an innovative way. 9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas. 9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option. 9.4.8.DC.1 Analyze the resource citation in online materials for proper use. 9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal. 9.4.8.IML.4 Ask insightful questions to organize different types of data and create meaningful visualizations. 9.4.8.IML.7 Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose. 9.4.8.IML.12 Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic

	audience. 9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem. 9.4.8.TL.3 Select appropriate tools to organize and present information digitally. 9.4.8.TL.6 Collaborate to develop and publish work that provides perspectives on a real-world problem.
Computer Science and Design Thinking	8.1.8.DA.1Organiza and transform data collected using computational tools to make it usable for a specific purpose. 8.2.8.ED.3 Develop a proposal for a solution to a real-world problem that includes a model. 8.2.8.ETW.2 Analyze the impact of modifying resources in a product or system.

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented	504
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE
MS. Energy
MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.
Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.
Evidence Statements: MS-PS3-3

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system.	**PS3.A: Definitions of Energy** Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **PS3.B: Conservation of Energy and Energy Transfer** Energy is spontaneously transferred out of hotter regions or objects and into colder ones. **ETS1.A: Defining and Delimiting an Engineering Problem** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary) **ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary)	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system.
Connections to other DCIs in this grade-band: MS.PS1.B ; MS.ESS2.A ; MS.ESS2.C ; MS.ESS2.D		
Articulation of DCIs across grade-bands: 4.PS3.B ; HS.PS3.B		
NJSLS- ELA: RST.6-8.3, WHST.6-8.7		
NJSLS- Math: N/A		
5E MODEL		
MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.		

Engage Anticipatory Set	Using the following resources have students view videos, read articles and engage in discussion about thermal energy transfer. Go to MS-PS3-3 section of the page. http://www.ck12.org/ngss/middle-school-physical-sciences/energy
Exploration Student Inquiry	Build a Solar Oven In this activity, students will design, test and construct a solar oven, providing a concrete example of thermal energy transfer. http://www.hometrainingtools.com/a/build-a-solar-oven-project Thermal Protection Systems: Day 1 In this activity, students will apply scientific principles to design, construct and test a device that either minimizes or maximises thermal energy transfer. http://betterlesson.com/lesson/634000/thermal-protection-systems-day-1
Explanation Concepts and 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): PS3.A: Definitions of Energy Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. PS3.B: Conservation of Energy and Energy Transfer Energy is spontaneously transferred out of hotter regions or objects and into colder ones. ETS1.A: Defining and Delimiting an Engineering Problem The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary) ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary)
Elaboration Extension Activity	Build a Thermos In this activity, students will design, construct and test a thermos structure to determine which model keeps the warmest temperature. http://betterlesson.com/lesson/628050/build-a-thermos

Evaluation Assessment Tasks	Assessment Task A Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. Students will be assessed based upon the execution of design and effectiveness of solar oven. If solar oven is not effective, students should demonstrate the ability to brainstorm solutions to modify and/or change design to make it work. Assessment Task B Thermal Protection System Design Challenge Student Lab Sheet

ENGINEERING DESIGN		
MS-ETS1-2 Engineering Design		
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Evidence Statements: MS-ETS1-2		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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. Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.	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.	
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.A ; HS.ETS1.B		
NJSLS- ELA: RST.6-8.1, RST.6-8.9, WHST.6-8.7 , WHST.6-8.9		
NJSLS- Math: MP.2, 7.EE.3		

ENGINEERING DESIGN		
MS-ETS1-3 Engineering Design		
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Evidence Statements: MS-ETS1-3		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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.	**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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.	
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Connections to MS-ETS1.C: Optimizing the Design Solution include: Physical Science: MS-PS1-6		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.B ; HS.ETS1.C		
NJSLS- ELA: RST.6-8.1, RST.6-8.7, RST.6-8.9		
NJSLS- Math: MP.2, 7.EE.3		

ENGINEERING DESIGN
MS-ETS1-4 Engineering Design
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
Evidence Statements: MS-ETS1-4

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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.	**ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions. ETS1.C: Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Connections to MS-ETS1.C: Optimizing the Design Solution include: Physical Science: MS-PS1-6		
Articulation of DCIs across grade-bands: 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.B ; HS.ETS1.C		
NJSLS- ELA: SL.8.5		
NJSLS- Math: MP.2, 7.SP		

PHYSICAL SCIENCE		
MS. Energy		
MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.		
Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.		
Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.		
Evidence Statements: MS-PS3-4		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Planning and Carrying Out Investigations	**PS3.A: Definitions of Energy**	**Scale, Proportion, and Quantity**

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. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. **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	Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. **PS3.B: Conservation of Energy and Energy Transfer** The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.	Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.
Connections to other DCIs in this grade-band: MS.PS1.A ; MS.PS2.A ; MS.ESS2.C ; MS.ESS2.D ; MS.ESS3.D		
Articulation of DCIs across grade-bands: 4.PS3.C ; HS.PS1.B ; HS.PS3.A ; HS.PS3.B		
NJSLS- ELA: RST.6-8.3, WHST.6-8.7		
NJSLS- Math: MP.2, 6.SP.B.5		
5E MODEL		
MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.		
Engage Anticipatory Set	Using the following resources have students view videos, read articles and engage in discussion on how energy, mass and mater impact temperatures. Go to MS-PS3-4 section of the page.	

	http://www.ck12.org/ngss/middle-school-physical-sciences/energy
Exploration Student Inquiry	Heat Transfer Lab Rotation: Conduction, Convection and Radiation In this lab activity, students will identify and explain the various ways that heat transfers through systems in the natural world. http://betterlesson.com/lesson/634878/heat-transfer-lab-rotation-conduction-convection-and-radiation Materials Affect the Rate of Heat Transfer - Experimental Design In this activity, students will compare different materials to determine which ones are better at preventing heat transfer. Using a given set of materials, students will work to design a penguin home which can maintain a cool temperature. http://betterlesson.com/lesson/635989/materials-affect-the-rate-of-heat-transfer-experimental-design
Explanation Concepts and 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): PS3.A: Definitions of Energy Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. PS3.B: Conservation of Energy and Energy Transfer The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environ
Elaboration Extension Activity	Related Activities http://participatoryscience.org/standard/ms-ps3-4
Evaluation Assessment Tasks	Assessment Task A: Materials Affect the Rate of Heat Transfer- Penguin Home Design Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Students will be evaluated on the planning and implementation of their penguin home design. The success of each student design will ultimately be tested by its ability to maintain a cool temperature.

ENGINEERING DESIGN		
MS-ETS1-1 Engineering Design		
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Evidence Statements: MS-ETS1-1		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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.	**ETS1.A: Defining and Delimiting Engineering Problems** The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	**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.
Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include: Physical Science: MS-PS3-3		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.C ; HS.ETS1.A ; HS.ETS1.B		
NJSLS- ELA: RST.6-8.1, WHST.6-8.8		
NJSLS- Math: MP.2, 7.EE.3		

Unit 6: Overview
Unit 6: The Electromagnetic Spectrum
Grade: 8
Content Area: Physical Science
Pacing: 20 Instructional Days
Essential Question
How do cell phones work?
Student Learning Objectives (Performance Expectations)
MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.
Unit Summary
In this unit of study, students develop and use models, use mathematical thinking, and obtain, evaluate, and communicate information in order to describe and predict characteristic properties and behaviors of waves. Students also apply their understanding of waves as a means of sending digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. Students develop and use models, use mathematical thinking, and obtain, evaluate, and communicate information.Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Amplitude, wavelength, electromagnetic waves, repeating waves, reflected waves, absorbed waves, transmitted, waves, refracted waves, analog signals, fiber optic cable, light pulses, radio wave pulses, binary patterns
Formative Assessment Measures
Part A: Why do surfers love physicists?
Students who understand the concepts are able to: Use mathematical representations to describe and/or support scientific conclusions about how the amplitude of a wave is related to the energy in a wave. Use mathematical representations to describe a simple model.
Part B: How do the light and sound system in the auditorium work?
Students who understand the concepts are able to: Develop and use models to describe the movement of waves in various materials.
Part C: If rotary phones worked for my grandparents, why did they invent cell phones?
Students who understand the concepts are able to:

<table>
<tr><td colspan="3">Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals are.</td></tr>
<tr><th colspan="3">Interdisciplinary Connections</th></tr>
<tr><th colspan="2">NJSLS- ELA</th><th>NJSLS- Mathematics</th></tr>
<tr><td colspan="2">Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3) RST.6-8.1
Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3) RST.6-8.2
Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3) RST.6-8.9
Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3) WHST.6-8.9
Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2) SL.8.5</td><td>Reason abstractly and quantitatively. (MS-PS4-1) MP.2
Model with mathematics. (MS-PS4-1) MP.4
Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1) 6.RP.A.1
Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1) 6.RP.A.3
Recognize and represent proportional relationships between quantities. (MS-PS4-1) 7.RP.A.2
Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1) 8.F.A.3</td></tr>
<tr><td>Core Instructional Materials</td><td colspan="2">Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.</td></tr>
<tr><td>Career Readiness, Life Literacies and Key Skills</td><td colspan="2">9.4.8/CI.2 Repurpose an existing resource in an innovative way.
9.4.8.CI.3 Examine challenges that may exist in the adoption of new ideas.
9.4.8.CT.2 Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option.
9.4.8.DC.1Analyze the resource citations in online materials for proper use.
9.4.8.IML.7 Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose.
9.4.8.IML.12 Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
9.4.8.TL.1 Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
9.4.8.TL.2 Gather data and digitally represent information to communicate a real-world problem.
9.4.8.TL.3 Select appropriate tools to organize and present information digitally.</td></tr>
</table>

Computer Science and Design Thinking	8.1.8.DA.1 Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.2.8 ED.3 Develop a proposal for a solution to a real-world problem that includes a model. 8,2.8.ED.7 Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs. 8.2.8.ITH.2 Compare how technologies have influenced society over time. 8.2.8.ETW.2 Analyze the impact of modifying resources in a product or system.

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented	504
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE		
MS. Waves and Their Applications in Technologies for Information Transfer		
MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.		
Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.		
Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.		
Evidence Statements: MS-PS1-4		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to describe and/or support scientific conclusions and design solutions. **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.	**PS4.A: Wave Properties** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	**Patterns** Graphs and charts can be used to identify patterns in data.
Connections to other DCIs in this grade-band: N/A		
Articulation of DCIs across grade-bands: 4.PS3.A ; 4.PS3.B ; 4.PS4.A ; HS.PS4.A ; HS.PS4.B		
NJSLS- ELA: SL.8.5		
NJSLS- Math: MP.2, MP.4, 6.RP.A.1, 6.RP.A.3, 7.RP.A.2, 8.F.A.3		

5E MODEL	
MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	
Engage Anticipatory Set	Types of Waves https://www.youtube.com/watch?v=w2s2fZr8sqQ Demonstration

	Use an example of "wall ball" and the bouncing of a ball. Predict where the ball will bounce given the angle of incidence. Relate this to the Law of Reflection and the angle of incidence and reflection. Discuss the difference between regular and diffused reflection.
Exploration Student Inquiry	Wave Behavior Labs In these lab activities, students will create simple mathematical representations of waves and identify characteristic properties of waves. Day 1: http://betterlesson.com/lesson/633386/wave-behavior-lab-rotation-day-1 Day 2 :http://betterlesson.com/lesson/633450/wave-behavior-lab-rotation-day-2
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): PS4.A: Wave Properties A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
Elaboration Extension Activity	Have students review the graphs they created during the lab. Ask them to predict the change in the energy of the wave if any one of the parameters of the wave is changed. Wavelength: http://www.ck12.org/physical-science/Wavelength-in-Physical-Science/ Wave Frequency: http://www.ck12.org/physical-science/Wave-Frequency-in-Physical-Science/ Wave Amplitude:http://www.ck12.org/physical-science/Wave-Amplitude-in-Physical-Science/
Evaluation Assessment Tasks	Assessment Task A: Graphing of Characteristics Properties of Waves Use mathematical representations to describe and/or support scientific conclusions and design solutions. http://betterlesson.com/lesson/resource/3158929/graphing-of-characteristic-properties-of-waves?from=resource_image Assessment Task B: Lab Closure Questions What evidence can you cite that different types of waves interact with matter in different ways? How can you create a mathematical representation of wave properties?

PHYSICAL SCIENCE		
MS. Waves and Their Applications in Technologies for Information Transfer		
MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.		
Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.		
Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.		
Evidence Statements: MS-PS4-2		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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 and use a model to describe phenomena.	**PS4.A: Wave Properties** A sound wave needs a medium through which it is transmitted. **PS4.B: Electromagnetic Radiation** When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	**Structure and Function** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Connections to other DCIs in this grade-band: MS.LS1.D		
Articulation of DCIs across grade-bands: 4.PS4.B ; HS.PS4.A ; HS.PS4.B ; HS.ESS1.A ; HS.ESS2.A ; HS.ESS2.C ; HS.ESS2.D		
NJSLS- ELA: SL.8.5		
NJSLS- Math: N/A		
5E MODEL		

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	
Engage Anticipatory Set	Provide an example of how light or sound can be reflected, absorbed or transmitted through a medium (between objects). Find one object within the classroom that will represent light being reflected, absorbed or transmitted and bring it back to your seat (examples of: translucent, opaque and transparent). The class will create a list on the Smartboard and discuss whether their "object" reflects, absorbs or transmits light and how/why they choose that "object." Introduction to Light Video: https://www.youtube.com/watch?v=yHJ_X_lXtB8 Indoor Rainbow: http://www.weatherwizkids.com/experiments-rainbow-indoor.htm http://www.bozemanscience.com/waves
Exploration Student Inquiry	What is a medium? What types of materials can light and sound pass through? How will sound/light passing through solids, liquids or gasses affect the energy (waves) that are transmitted? What real-life situations/experiences can you use as examples to support your thinking? Light Activity: Exploring Light: Absorb, Reflect, Transmit or Refract? https://www.teachengineering.org/view_activity.php?url=collection/van_/activities/van_troll/van_troll_lesson02_activity1.xml Sound Activity: http://www.ehow.com/info_8119201_sound-wave-experiments-kids.html Water Activities: https://www.ck12.org/physical-science/Mechanical-Wave-in-Physical-Science/
Explanation Concepts and 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): PS4.A: Wave Properties A sound wave needs a medium through which it is transmitted. (MS-PS4-2) PS4.B: Electromagnetic Radiation When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

Elaboration Extension Activity	Sunscreens and Sunburns http://www.haspi.org/uploads/6/5/2/9/65290513/06_physical_-_sunscreen.pdf
Evaluation Assessment Tasks	Assessment Task A Develop and use a model to describe phenomena. After completing Exploring Light Properties Investigation, students will complete the What Did You Learn Today? worksheet to describe that waves are reflected, absorbed, or transmitted through various materials.

PHYSICAL SCIENCE		
MS. Waves and Their Applications in Technologies for Information Transfer		
MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.		
Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.		
Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.		
Evidence Statements: MS-PS4-3		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. Integrate qualitative scientific and technical information in written text with that contained in media	**PS4.C: Information Technologies and Instrumentation** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	**Structure and Function** Structures can be designed to serve particular functions. **Connections to Engineering, Technology, and Applications of Science** Influence of Science, Engineering, and Technology on Society and the Natural World Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. **Connections to Nature of Science** **Science is a Human Endeavor** Advances in technology influence the progress of science and science has influenced advances in technology.

and visual displays to clarify claims and findings.		

Connections to other DCIs in this grade-band: N/A

Articulation of DCIs across grade-bands: 4.PS4.C ; HS.PS4.A ; HS.PS4.C

NJSLS- ELA: RST.6-8.1, RST.6-8.2, RST.6-8.9, WHST.6-8.9

NJSLS- Math: N/A

5E MODEL

MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

Engage Anticipatory Set	Analog vs. Digital Video: http://www.diffen.com/difference/Analog_vs_Digital Guiding Question Besides digital (computers, phones, etc.) what are other ways that you have heard/seen/read of transmitting information (mail, music, video, etc.) without the use of computers?
Exploration Student Inquiry	http://educators.brainpop.com/bp-topic/analog-and-digital-recording/ Day 1: Have students read the following article about analog vs. digital media and information http://www.diffen.com/difference/Analog_vs_Digital What are examples of analog vs. digital media? How has the real world transitioned from analog to digital in the last 10 years? Please provide examples from your life where you were able to see and record these changes. Day 2: Examples of Media to Explore: Music, Images, Phone/Communication, Maps/Satellites, Video Games (8 bit cartridges vs. now can download to console - no disc required!), shopping (go to mall vs. online shopping). Below is a list of items that students can be asked to research how it has changed/grown to be more digital as time has gone by. It is important for students to realize the resources and learning potential they NOW have available to them (that once did not exist due to technological constraints). Clocks, Medical Devices, Telephones, Cassettes/Radio vs. Pandora/Sirius, Paper Maps vs. Google Maps/Earth, Cars Day 3:

	Digital vs. Analog Signal Project: Students will be able to explain why digital wave signals are a more reliable way of communicating information than analog wave signals. https://sciencewithmrsbowling.wordpress.com/resources/digital-vs-analog-signal-project/
Explanation Concepts and 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): PS4.C: Information Technologies and Instrumentation Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)
Elaboration Extension Activity	http://faraday.theiet.org/resources/overview/analogue-digital.cfm Bluetooth and WiFi: How do they work? What is actually being transmitted? How have these technologies help to make every day "activities" easier? (Communication, Satellites, NASA Probe Missions - Pluto, Fiber Optic Cables vs. Dial-Up). What's a cloud?
Evaluation Assessment Tasks	Assessment Task A Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. After completed Day 3 (Digital vs. Analog Signal Project), students will explain in written text why digital signals are better than analog signals.

Unit 7: Overview
[Unit 7: Force and Motion]
Grade: 8
Content Area: Physical Science
Pacing: 25 Instructional Days
Essential Question
How can we predict the motion of an object?
Student Learning Objectives (Performance Expectations)
MS-PS2-1. Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects.
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-PS2-2. Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
Unit Summary
Students use system and system models and stability and change to understanding ideas related to why some objects will keep moving and why objects fall to the ground. Students apply Newton’s third law of motion to related forces to explain the motion of objects. Students also apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of system and system models and stability and change provide a framework for understanding the disciplinary core ideas. Students demonstrate proficiency in asking questions, planning and carrying out investigations, designing solutions, engaging in argument from evidence, developing and using models, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Newton's Third Law of Motion, friction, force, potential energy, kinetic energy, gravity, transfer, incline/decline, balanced/unbalanced forces, net force, momentum, velocity, weight, inertia

Formative Assessment Measures
Part A: How does a sailboat work?
<u>Students who understand the concepts are able to:</u>
Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects. Define a design problem involving the motion of two colliding objects that can be solved through the development of an object, tool, process, or system and that includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. Evaluate competing design solutions involving the motion of two colliding objects based on jointly developed and agreed-upon design criteria. Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. Analyze and interpret data to determine similarities and differences in findings.
Part B: Who can build the fastest sailboat?
<u>Students who understand the concepts are able to:</u> Plan an investigation individually and collaboratively to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. Design an investigation and identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how much data is needed to support a claim. Make logical and conceptual connections between evidence and explanations. Examine the changes over time and forces at different scales to explain the stability and change in designed systems.

Interdisciplinary Connections	
NJSLS- ELA	**NJSLS- Mathematics**
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS2-1),(MS-ETS1-1),(MS-ETS1-2) RST.6-8.1 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1),(MS-PS2-2) RST.6-8.3 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the	Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3),(MS-ETS1-1),(MS-ETS1-2) MP.2 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1) 6.NS.C.5 Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1),(MS-PS2-2) 6.EE.A.2 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to

data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) WHST.6-8.8 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) WHST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) RST.6-8.9 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2) WHST.6-8.7	calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-PS2-1),(MS-PS2-2) 7.EE.B.3 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-PS2-1),(MS-PS2-2) 7.EE.B.4 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2) 7.EE.3

Core Instructional Materials	Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.
Career Readiness, Life Literacies and Key Skills	9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2). 9.4.8.IML.12: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience. 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2). 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data.
Computer Science and Design Thinking	8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches). 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital). 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.

Modifications

English Language Learners	Special Education	At-Risk	Gifted and Talented	504
Scaffolding Word walls Sentence/paragraph frames	Word walls Visual aides Graphic organizers	Teacher tutoring Peer tutoring Study guides	Curriculum compacting Challenge assignments Enrichment activities	Word walls Visual aides Graphic organizers

Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Graphic organizers Extended time Parent communication Modified assignments Counseling	Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE		
MS. Motion and Stability: Forces and Interactions		
MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.		
Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.		
Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.		
Evidence Statements: MS-PS2-1		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent	**PS2.A: Forces and Motion** For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	**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. **Connections to Engineering,Technology, and Applications of Science** **Influence of Science, Engineering, and Technology on Society and the Natural World** The uses of technologies and any 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.

with scientific ideas, principles, and theories. Apply scientific ideas or principles to design an object, tool, process or system.		

Connections to other DCIs in this grade-band: MS.PS3.C

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

NJSLS- ELA: RST.6-8.1, RST.6-8.3, WHST.6-8.7

NJSLS- Math: MP.2, 6.NS.C.5, 6.EE.A.2, 7.EE.B.3, 7.EE.B.4

5E Model

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

Engage Anticipatory Set	Go to link and click Newton's Third Law, then video. http://www.ck12.org/ngss/middle-school-physical-sciences/motion-and-stability:-forces-and-interactions Outline the action and reaction demonstrated by the astronauts in the video. Why does wearing the battery pack affect the motion of the astronaut named Alexander? Describe an example of Newton's cradle. How do space vehicles apply action and reaction forces to blast off? Lead class discuss: - State Newton's third law of motion. - Describe an example of an action and reaction. Identify the forces and their directions. - Explain why action and reaction forces are not balanced forces. Collision Video https://www.youtube.com/watch?v=xtxd27jlZ_g&feature=c4-overview-vl&list=PL983889014322C331 What are the engineers testing in these crash tests? How do you think we can predict the direction of the collisions? How does mass impact car collisions?
Exploration Student Inquiry	Newton's Third Law Lesson Plan The first two activities help students to review Newton's laws and forces acting on an object. In the culminating task, students are asked to design, test, and redesign a moon lander and rover. 1. Forces in Motion Activity

	2. Describing Motion Activity The final project gives students design constraints and asks them to reflect and retest their design. Teachers should plan on the culminating activity as a 3-4 day project (unless students are working at home). Minimal teacher prep is required and most of the materials given to students can be basic household items and things you have around the classroom. 3. Moon Rover - Final Activity
Explanation Concepts and 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.A: Forces and Motion For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
Elaboration Extension Activity	Balloon Rockets https://sciencebob.com/make-a-balloon-rocket/
Evaluation Assessment Tasks	Assessment Task A: Moon Rover Apply scientific ideas or principles to design an object, tool, process or system. Students will be able to apply Newton's 3rd Law of Motion to design a solution to landing a rover on the Moon. Use the attached rubric to assess students upon completion of design project. Moon Rover Engineering Design Plan Rubric

ENGINEERING DESIGN		
MS-ETS1-1 Engineering Design		
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.		
Evidence Statements: MS-ETS1-1		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Asking Questions and Defining Problems	**ETS1.A: Defining and Delimiting Engineering Problems**	**Influence of Science, Engineering, and Technology on Society and the Natural World**

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.	The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.	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.
Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include: Physical Science: MS-PS3-3		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.C ; HS.ETS1.A ; HS.ETS1.B		
NJSLS- ELA: RST.6-8.1, WHST.6-8.8		
NJSLS- Math: MP.2, 7.EE.3		

ENGINEERING DESIGN		
MS-ETS1-2 Engineering Design		
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Evidence Statements: MS-ETS1-2		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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	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.	

explanations or solutions about the natural and designed world. Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.		
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.A ; HS.ETS1.B		
NJSLS ELA: RST.6-8.1, RST.6-8.9, WHST.6-8.7 , WHST.6-8.9		
NJSLS- Math: MP.2, 7.EE.3		

ENGINEERING DESIGN		
MS-ETS1-3 Engineering Design		
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
Evidence Statements: MS-ETS1-3		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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.	**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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign	

	process—that is, some of those characteristics may be incorporated into the new design.	

Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5
Connections to MS-ETS1.C: Optimizing the Design Solution include: Physical Science: MS-PS1-6
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.B ; HS.ETS1.C
NJSLS- ELA: RST.6-8.1, RST.6-8.7, RST.6-8.9
NJSLS- Math: MP.2, 7.EE.3

PHYSICAL SCIENCE
MS. Motion and Stability: Forces and Interactions
MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.
Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.
Evidence Statements: MS-PS2-2

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. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the	**PS2.A: Forces and Motion** The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. All positions of objects and the directions of forces and motions must be described	**Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

gathering, how measurements will be recorded, and how many data are needed to support a claim. **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.	in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	
Connections to other DCIs in this grade-band: MS.PS3.A ; MS.PS3.B ; MS.ESS2.C		
Articulation of DCIs across grade-bands: 3.PS2.A ; HS.PS2.A ; HS.PS3.B ; HS.ESS1.B		
NJSLS- ELA: RST.6-8.3, WHST.6-8.7		
NJSLS- Math: MP.2, 6.EE.A.2, 7.EE.B.3, 7.EE.B.4		

5E Model	
MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	
Engage Anticipatory Set	Begin lesson by carrying out one of the Newton's Law Demonstrations from the following resource http://www.exo.net/~donr/activities/Newton's_Laws_Demonstrations.pdf Have students explore the following interactive site. This site will allow students to explore how gravity impacts the motion of objects. http://www.glencoe.com/sites/common_assets/science/virtual_labs/E25/E25.html
Exploration Student Inquiry	Marble Roll- Let's Move It http://it.pinellas.k12.fl.us/Teachers3/gurianb/files/AD5483E493EE4299BDAF1BABAD473540.pdf Ask groups to set up their experiment. Provide the "Science Mini-boards" to record their data and have a notebook for them to record observations. During the actual experiments time, the teacher should be constantly assessing, looking for and correcting misconceptions. This is also where the teacher should be doing a lot of "playing dumb" and asking lots of "whys". Probing is essential to encourage scientific discussions. Student Procedures (See mini-board): 1. Decide on the number of books your group will use for this experiment. 2. Make your hypothesis about what you think will happen in your experiment. 3. Find the mass of the marbles. 4. Set up books and put the ruler

	on the edge. 5. Put the carton at the base of the ruler. 6. Use a pencil to hold the marble 2 inches from the top of the ruler. 7. Release the pencil so that no force is applied to the marble. 8. Measure the distance the carton was moved. 9. Repeat for a total of 10 trials. 10. The teacher will teach you how to use a calculator to find the average or mean. 11. Repeat procedures for the next marble.
Explanation Concepts and 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.A: Forces and Motion The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.
Elaboration Extension Activity	Science of NFL Football: Newton's Second Law of Motion http://science360.gov/obj/video/58e62534-e38d-430b-bfb1-c505e628a2d4/science-nfl-football-newtons-second-law-motion
Evaluation Assessment Tasks	Assessment Task A: Marble Roll Experiment Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. Students will complete the Science Mini Board to provide evidence of mastery of the standard. Mini Board - pages 5 & 6

ENGINEERING DESIGN		
MS-ETS1-4 Engineering Design		
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		
Evidence Statements: MS-ETS1-4		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Developing and Using Models	**ETS1.B: Developing Possible Solutions**	

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.	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions. ETS1.C: Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Connections to MS-ETS1.C: Optimizing the Design Solution include: Physical Science: MS-PS1-6		
Articulation of DCIs across grade-bands: 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.B ; HS.ETS1.C		
NJSLS- ELA: SL.8.5		
NJSLS- Math: MP.2, 7.SP		

Unit 8: Overview
Unit 8: Chemical Reactions
Grade: 8
Content Area: Physical Science
Pacing: 25 Instructional Days
Essential Question
How do substances combine or change (react) to make new substances?
Student Learning Objectives (Performance Expectations)
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
Unit Summary
Students provide molecular-level accounts of states of matters and changes between states, of how chemical reactions involve regrouping of atoms to form new substances, and of how atoms rearrange during chemical reactions. Students also apply their understanding of optimization design and process in engineering to chemical reaction systems. The crosscutting concept of energy and matter provides a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students are also expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.
Technical Terms
Thermal energy, kinetic molecular theory, conduction, convection, radiation, thermal equilibrium, kelvin, specific heat, calorimeter, thermodynamics, melting point, boiling point, Law of Conservation of Matter, reactants, products, coefficients, subscripts, chemical equations
Formative Assessment Measures
Part A: What happens to the atoms when I bake a cake?
Students who understand the concepts are able to:

Use physical models or drawings, including digital forms, to represent atoms in a chemical process. Use mathematical descriptions to show that the number of atoms before and after a chemical process is the same.
Part B: How can a device be designed, constructed, tested, and modified that either releases or absorbs thermal energy by chemical processes?
<u>Students who understand the concepts are able to:</u> Undertake a design project, engaging in the design cycle, to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. Specific criteria are limited to amount, time, and temperature of a substance. Analyze and interpret data for the amount, time, and temperature of a substance in testing a device that either releases or absorbs thermal energy by chemical processes to determine similarities and differences in findings. Develop a model to generate data for testing a device that either releases or absorbs thermal energy by chemical processes, including those representing inputs and outputs of thermal energy. Track the transfer of thermal energy as energy flows through a designed system that either releases or absorbs thermal energy by chemical processes.

Interdisciplinary Connections	
NJSLS- ELA	**NJSLS- Mathematics**
Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-3) RST.6-8.1 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6) RST.6-8.3 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-PS1-5) RST.6-8.7 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-3) RST.6-8.9 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions	Reason abstractly and quantitatively. (MS-PS1-5) (MS-ETS1-3) MP.2 Model with mathematics. (MS-PS1-5) MP.4 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-3) 7.EE.3

that allow for multiple avenues of exploration. (MS-PS1-6) (MS-ETS1-3) WHST.6-8.7 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-5) 6.RP.A.3	

Core Instructional Materials	Lab-Aids, Lab Materials, household chemicals and materials, string, craft sticks, hot glue and glue guns, Nearpod, Scholastic Magazine, Blooket.
Career Readiness, Life Literacies and Key Skills	9.4.8.CI.1: Assess data gathered on varying perspectives on causes of climate change (e.g., crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4). 9.4.8.CI.2: Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3). 9.4.8.CI.3: Examine challenges that may exist in the adoption of new ideas (e.g., 2.1.8.SSH, 6.1.8.CivicsPD.2). 9.4.8.CI.4: Explore the role of creativity and innovation in career pathways and industries. 9.4.8.CT.1: Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2). 9.4.8.CT.2: Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1). 9.4.8.CT.3: Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome. 9.4.8.DC.1: Analyze the resource citations in online materials for proper use. 9.4.8.DC.2: Provide appropriate citation and attribution elements when creating media products (e.g., W.6.8). 9.4.8.DC.8: Explain how communities use data and technology to develop measures to respond to effects of climate change (e.g., smart cities). 9.4.8.GCA.2: Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal. 9.4.8.IML.1: Critically curate multiple resources to assess the credibility of sources when searching for information. 9.4.8.IML.4: Ask insightful questions to organize different types of data and create meaningful visualizations. 9.4.8.IML.5: Analyze and interpret local or public data sets to summarize and effectively communicate the data. 9.4.8.IML.7: Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).

	9.4.8.IML.8: Apply deliberate and thoughtful search strategies to access high-quality information on climate change (e.g., 1.1.8.C1b) 9.4.8.IML.12: Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience. 9.4.8.TL.1: Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making 9.4.8.TL.2: Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4). 9.4.8.TL.3: Select appropriate tools to organize and present information digitally. 9.4.8.TL.4: Synthesize and publish information about a local or global issue or event (e.g., MSLS4-5, 6.1.8.CivicsPI.3). 9.4.8.TL.6: Collaborate to develop and publish work that provides perspectives on a real-world problem.
Computer Science and Design Thinking	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.6: Analyze climate change computational models and propose refinements. 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem. 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team. 8.2.8.ED.5: Explain the need for optimization in a design process. 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product. 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches). 8.2.8.ITH.2: Compare how technologies have influenced society over time. 8.2.8.ITH.4: Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact. 8.2.8.ITH.5: Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another. 8.2.8.NT.4: Explain how a product designed for a specific demand was modified to meet a new demand and led to a new product.

	8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital). 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact. 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.

Modifications				
English Language Learners	**Special Education**	**At-Risk**	**Gifted and Talented**	**504**
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair- share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast Parent communication Modified assignments Counseling

PHYSICAL SCIENCE		
MS. Matter and Its Interactions		
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.		
Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.		
Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.		
Evidence Statements: MS-PS1-5		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
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. **Connections to Nature of Science** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** Laws are regularities or mathematical descriptions of natural phenomena.	**PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change.	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes.
Connections to other DCIs in this grade-band: MS.LS1.C ; MS.LS2.B ; MS.ESS2.A		
Articulation of DCIs across grade-bands: 5.PS1.B ; HS.PS1.B		
NJSLS- ELA: RST.6-8.7		
NJSLS- Math: MP.2, MP.4, 6.RP.A.3		

5E Model	
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	
Engage Anticipatory Set	What is a Chemical Reaction: Candle Demonstration The teacher will use a small candle flame to demonstrate a chemical reaction between the candle wax and oxygen in the air. http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson1 (Complete numbers 1-4)

Exploration Student Inquiry	Have students view the following video: The Law of Conservation of Mass https://www.youtube.com/watch?v=2S6e11NBwiw What is a Chemical Reaction? http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson1 Students will see a molecular animation of the combustion of methane and oxygen as a model of a similar reaction. Students will use atom model cut-outs to model the reaction and see that all the atoms in the reactants show up in the products. Students will be able to explain that for a chemical reaction to take place, the bonds between atoms in the reactants are broken, the atoms rearrange, and new bonds between the atoms are formed to make the products. Students will also be able to explain that in a chemical reaction, no atoms are created or destroyed.
Explanation Concepts and 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): PS1.B: Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus the mass does not change.
Elaboration Extension Activity	Have students create computer-generated models of both experiments using Google slides or another similar application in order to depict how the total number of atoms does not change in a chemical reaction. Labels should be written with details and include the following vocabulary terms: chemical and physical change, reactants, reaction, and law of conservation of mass.
Evaluation Assessment Tasks	Assessment Task A Develop a model to describe unobservable mechanisms. Students will create a model using atom model cut-outs. Teachers should assess the completion of the Student Activity Sheet.

ENGINEERING DESIGN		
MS-ETS1-4 Engineering Design		
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		
Evidence Statements: MS-ETS1-4		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**

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.	**ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions. ETS1.C: Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.	
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Connections to MS-ETS1.C: Optimizing the Design Solution include: Physical Science: MS-PS1-6		
Articulation of DCIs across grade-bands: 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.B ; HS.ETS1.C		
NJSLS- ELA: SL.8.5		
NJSLS- Math: MP.2, 7.SP		

PHYSICAL SCIENCE		
MS. Matter and Its Interactions		
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.		
Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.		
Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device,		
Evidence Statements: MS-PS1-6		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds	**PS1.B: Chemical Reactions** Some chemical reactions release energy, others store energy. **ETS1.B: Developing Possible Solutions**	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system.

on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.	A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary) **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (secondary) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary)	
Connections to other DCIs in this grade-band: MS.PS3.D		
Articulation of DCIs across grade-bands: HS.PS1.A ; HS.PS1.B ; HS.PS3.A ; HS.PS3.B ; HS.PS3.D		
NJSLS- ELA: RST.6-8.3, WHST.6-8.7		
NJSLS- Math: N/A		

5E Model	
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	
Engage Anticipatory Set	Chemical Reactions and Engineering Design http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson11 Using the Student Activity Sheet, take students through the Design the Problem section of the activity. In the story, the eggs need to be moved while they are protected and kept at a specific temperature range. Students observe heat packs that use different chemical processes as possible heat sources for their device. As a class, students identify the features the device should have to be successful (criteria) as well as the factors that might limit or impede the development of a successful design (constraints).
Exploration Student Inquiry	Chemical Reactions and Engineering Design http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson11

	Students will design, test, modify, and optimize a device that uses a chemical reaction to reach a specific temperature range for a portable reptile egg incubator. *Note: Students will not be expected to build every element of the heat pack such as incorporating a pouch of water into the pack. Their main goal is to achieve the target temperature range and to design, on paper, the final device.*
Explanation Concepts and 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): PS1.B: Chemical Reactions Some chemical reactions release energy, others store energy. ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary) ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (secondary) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary)
Elaboration Extension Activity	Related Activities Better Lessons: MS-PS1-6
Evaluation Assessment Tasks	Assessment Task A Students will complete the Reptile Egg Identification Chart. After determining the target temperature range, students use water and different amounts of calcium chloride and baking soda to achieve the right temperature and produce enough gas to support the egg and cushion against impact. Assessment Task B Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. Students will design, test, modify, and optimize a device that uses a chemical reaction to reach a specific temperature range for a portable reptile egg incubator.

	Note: Students will not be expected to build every element of the heat pack such as incorporating a pouch of water into the pack. Their main goal is to achieve the target temperature range and to design, on paper, the final device.

ENGINEERING DESIGN		
MS-ETS1-2 Engineering Design		
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
Evidence Statements: MS-ETS1-2		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Engaging in Argument from Evidence	ETS1.B: Developing Possible Solutions	
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.	There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.	
Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.		
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.A ; HS.ETS1.B		
NJSLS- ELA: RST.6-8.1, RST.6-8.9, WHST.6-8.7 , WHST.6-8.9		
NJSLS- Math: MP.2, 7.EE.3		

ENGINEERING DESIGN
MS-ETS1-3 Engineering Design
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
Evidence Statements: MS-ETS1-3

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
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.	**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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.	
Connections to MS-ETS1.B: Developing Possible Solutions Problems include: Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5		
Connections to MS-ETS1.C: Optimizing the Design Solution include: Physical Science: MS-PS1-6		
Articulation of DCIs across grade-bands: 3-5.ETS1.A ; 3-5.ETS1.B ; 3-5.ETS1.C ; HS.ETS1.B ; HS.ETS1.C		
NJSLS- ELA: RST.6-8.1, RST.6-8.7, RST.6-8.9		
NJSLS- Math: MP.2, 7.EE.3		