Moonachie School District
Science Curriculum:
Grade 8

New Jersey Student Learning Standards for Science

Born On: August 23, 2022
Re-Adopted: August 26, 2025

Unit 1: Overview
Unit 1: Evidence of a Common Ancestry
Grade: 8
Content Area: Life Science
Pacing: 20 Instructional Days
Essential Questions
How do we know when an organism (fossil) was alive?
How do we know that birds and dinosaurs are related?
Student Learning Objectives (Performance Expectations)
MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
Unit Summary
In this unit of study, students analyze graphical displays and gather evidence from multiple sources in order to develop an understanding of how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students search for patterns in the evidence to support their understanding of the fossil record and how those patterns show relationships between modern organisms and their common ancestors. The crosscutting concepts of cause and effect, patterns, and structure and function are called out as organizing concepts for these disciplinary core ideas.Students use the practices of analyzing graphical displays and gathering, reading, and communicating information.Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Biological Evolution, Fossil records, Existence, Diversity, Unity, Anatomical Structures, Chronological order, Rock layers, Anatomical,evolutionary, gross appearance, anatomy, embryological development, macroscopic, sediment, amber, radiometric dating, relative dating,chronometric, cladograms, homologous structure, morphology, DNA, trait, cladistics,embryos, nonlinear relationships
Formative Assessment Measures
Part A: How do we know when an organism (fossil) was alive?
Students who understand the concepts are able to: Use graphs, charts, and images to identify patterns within the fossil record. Analyze and interpret data within the fossil record to determine similarities and differences in findings. Make logical and conceptual connections between evidence in the fossil record and explanations about the existence, diversity, extinction, and change in many life forms throughout the history of life on Earth.
Part B: How do we know that birds and dinosaurs are related?
Students who understand the concepts are able to: Apply scientific ideas to construct explanations for evolutionary relationships. Apply the patterns in gross anatomical structures among modern organisms and between modern organisms and fossil organisms to construct explanations of

evolutionary relationships.
Apply scientific ideas about evolutionary history to construct an explanation for evolutionary relationships evidenced by similarities or differences in the gross appearance of anatomical structures.

Part C: Other than bones and structures being similar, what other evidence is there that birds and dinosaurs are related?

Students who understand the concepts are able to:
Use diagrams or pictures to identify patterns in embryological development across multiple species.
Analyze displays of pictorial data to identify where the embryological development is related linearly and where that linear nature ends.
Infer general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.

Interdisciplinary Connections

NJSLS- ELA	NJSLS- Mathematics
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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.	8.EE.C.7.A Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers).

SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	

Core Instructional Materials	Textbooks Series, Lab Materials, etc.
Career Readiness, Life Literacies and Key Skills	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.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 types of data and create meaningful visualizations. 9.4.8.IML.5 Analyzeand 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. 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.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.
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 (e.g., physical prototype, sketch).

Modifications

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

Modeling Cognates	Highlighter Color contrast			Highlighter Color contrast Parent communication Modified assignments Counseling

LIFE SCIENCE		
MS-LS4-1 Biological Evolution: Unity and Diversity		
MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.		
Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.		
Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.		
Evidence Statements: MS-LS4-1		
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. **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.	**LS4.A: Evidence of Common Ancestry and Diversity** The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
Connections to other DCIs in this grade-band: MS.ESS1.C ; MS.ESS2.B		
Articulation of DCIs across grade-bands: 3.LS4.A ; HS.LS4.A ; HS.ESS1.C		

5E Model	
MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.	
Engage Anticipatory Set	What Are Fossils

	http://www.ck12.org/biology/Fossils/lecture/user:13IntC/What-are-fossils/?referrer=concept_details&conceptLevel=&conceptSource=all Show several different fossils or pictures of fossils (diverse types of fossils and fossils from different time periods) and ask students what characteristics the fossils have and how they compare to organisms that still exist today – identify names of present day organisms similar to the fossilized organisms How is the present day organism SIMILAR to the extinct species? WHY are the two species similar? How is the present day organism DIFFERENT than the extinct species? WHY are the two species different? http://www.fossilmuseum.com/ http://www.bbc.co.uk/nature/fossils
Exploration Student Inquiry	Fossil Evidence for Evolution http://www.pbslearningmedia.org/resource/tdc02.sci.life.evo.lp_fossilevid/the-fossil-evidence-for-evolution/ In this lesson, students will learn how scientists find evidence of evolution and piece together the history of life. Students will learn about the fossil record, the primary form of evidence, as well as the fossil formation process and the evolution of animals.
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): LS4.A: Evidence of Common Ancestry and Diversity The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth.
Elaboration Extension Activity	Related Activities Better Lessons: MS-LS4-1
Evaluation Assessment Tasks	Assessment Task A: Whale Evolution Timeline (Part 3 Step 10 of lesson plan from PBS learning website) Ask each team of two to prepare an Eocene epoch timeline on paper, using the same scale as the classroom model (one inch equals one million years). Their timelines should be twenty-one inches long, with each million years labeled. Whales in the Making Using the images provided on the Whales in the Making worksheet, students will create timeline which represents the evolution of whales. Assessment Task B: Discussion Questions Analyze and interpret data to determine similarities and differences in findings. After creating the timeline, students should use the following discussion questions to interpret and analyze the data collected. What typical whale like traits were apparently the earliest to appear? What apparently evolved much later? As each "missing link" was found, how many new gaps were formed? What is the relationship between gaps and fossils? To find fossil evidence to fill the largest remaining gap in whale evolution, what age sediments would you search?

	What distinguishing traits would you expect to find in whale fossils of that age? Explain why the absence of transitional fossils does not mean that evolution didn't take place.

LIFE SCIENCE		
MS-LS4-2 Biological Evolution: Unity and Diversity		
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.		
Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.		
Assessment Boundary: N/A		
Evidence Statements: MS-LS4-2		
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 to construct an explanation for real-world phenomena, examples, or events.	**LS4.A: Evidence of Common Ancestry and Diversity** Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.	**Patterns** Patterns can be used to identify cause and effect relationships. **Connections to Nature of Science** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.
Connections to other DCIs in this grade-band: MS.LS3.A ; MS.LS3.B ; MS.ESS1.C		
Articulation of DCIs across grade-bands: 3.LS4.A ; HS.LS4.A ; HS.ESS1.C		

5E Model	
MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	
Engage Anticipatory Set	Students will compare images of an elephant shrew, an elephant, and a shrew to predict which two are most closely related based on observable anatomical characteristics https://www.sciencenews.org/article/elephant-shrews-are-oddly-related-actual-elephants
Exploration Student Inquiry	Cladistics Students will infer evolutionary relationships using a cladogram. http://betterlesson.com/lesson/638611/cladistics Evolution - Homologous Structures & Embryology Students will be able to identify similarities in morphology and early embryo development as evidence for evolution

	http://betterlesson.com/lesson/638268/evolution-homologous-structures-embryology
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): LS4.A: Evidence of Common Ancestry and Diversity Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.
Elaboration Extension Activity	Additional Cladogram Activities http://www.isd622.org/cms/lib07/MN01001375/Centricity/Domain/718/Learning_Target_4.6_Cladograms.pdf http://www.biologycorner.com/worksheets/cladogram.html#.VXBu00a8qSo http://chapin.episd.org/common/pages/DisplayFile.aspx?itemId=3070611
Evaluation Assessment Tasks	Assessment Task A: Evaluate the accuracy of the completed Cladogram that student built in the Cladistics activity. Assessment Task B: Closing Explanation Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. At the end of the lesson, pose the following question to students In your opinion, what is the most compelling evidence for evolution. Why? Encourage students to use the ACE strategy to answer. See link below. ACE Strategy

LIFE SCIENCE		
MS-LS4-3 Biological Evolution: Unity and Diversity		
MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.		
Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.		
Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.		
Evidence Statements: MS-LS4-3		
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	**LS4.A: Evidence of Common Ancestry and Diversity** Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	**Patterns** Graphs, charts, and images can be used to identify patterns in data.

causation, and basic statistical techniques of data and error analysis. Analyze displays of data to identify linear and nonlinear relationships.		
Connections to other DCIs in this grade-band: N/A		
Articulation of DCIs across grade-bands: HS.LS4.A		
5E Model		
MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.		
Engage Anticipatory Set	Guess the Embryo Interactive http://www-tc.pbs.org/wgbh/nova/assets/swf/1/embryo/embryo.swf	
Exploration Student Inquiry	Embryo Comparison Activity Given pictorial data, students will compare patterns of similarities in embryos to identify relationships across multiple species Which of the identified characteristics are still present in the fully formed anatomy of each species? Exploration Questions What does the presence or absence of embryological characteristics in the fully formed anatomy suggest about relationships among these species? Embryonic Development- Evidence for Evolution In this activity, students will analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. http://betterlesson.com/lesson/637398/embryonic-development-evidence-for-evolution	
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): LS4.A: Evidence of Common Ancestry and Diversity Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.	
Elaboration Extension Activity	Related Activities http://www.ck12.org/search/?q=MS-LS4-3&referrer=top_nav&autoComplete=false	
Evaluation Assessment Tasks	Assessment Task A: Embryonic Development Exit Slip Analyze displays of data to identify linear and nonlinear relationships. Students complete an Exit Slip, where they are required to write a scientific explanation on how embryo development across species is evidence for evolution.	

Unit 2: Overview
Unit 2: Selection and Adaptation
Grade: 8
Content Area: Life Science
Pacing: 20 Instructional Days
Essential Question
Are Genetically Modified Organisms (GMO) safe to eat?
Student Learning Objectives (Performance Expectations)
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
Unit Summary
Students construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They will use ideas of genetic variation in a population to make sense of how organisms survive and reproduce, thus passing on the traits of the species. The crosscutting concepts of patterns and structure and function are called out as organizing concepts that students use to describe biological evolution. Students use the practices of constructing explanations, obtaining, evaluating, and communicating information, and using mathematical and computational thinking. Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Natural selection, genetics, traits, probability, proportional reasoning, inheritance, artificial selection, genetic modifications, animal husbandry, gene therapy, mathematical models,adaptations, variables, Darwin Theory, genetic technology, selective breeding, extinct, transgenic, consumer, domestic, clone, synthesize, mutation, camouflage, industrial melanism, entomologist, simulation
Formative Assessment Measures
Part A: How can changes to the genetic code increase or decrease an individual's chances of survival?
Students who understand the concepts are able to: Construct an explanation that includes probability statements regarding variables and proportional reasoning of how genetic variations of traits in a population increase some individuals' probability surviving and reproducing in a specific environment. Use probability to describe some cause-and-effect relationships that can be used to explain why some individuals survive and reproduce in a specific environment.
Part B: How can the environment affect natural selection?
Students who understand the concepts are able to: Explain some causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time.

Use mathematical representations to support conclusions about how natural selection may lead to increases and decreases of genetic traits in populations over time.

Part C: Are Genetically Modified Organisms (GMO) safe to eat?

Students who understand the concepts are able to:

Gather, read, and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) from multiple appropriate sources.

Describe how information from publications about technologies and methods that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) used are supported or not supported by evidence.

Assess the credibility, accuracy, and possible bias of publications and the methods they used when gathering information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection).

Interdisciplinary Connections

NJSLS- ELA	NJSLS- Mathematics
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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	8.F.B. Use functions to model relationships between quantities. 4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. 5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. 8.EE.B. Understand the connections between proportional relationships, lines, and linear equations. 8.SP.A.1 Investigate patterns of association in bivariate data: Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

for multiple avenues of exploration. SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	

Core Instructional Materials	Textbooks Series, Lab Materials, etc.
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.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. 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.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.IML.1 Critically curate multiple resources to assess the credibility of sources when searching for information. 9.4.8.IML.7 Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose. 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. 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. 8.2.8.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.ETW.2 Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time,tools,people, capital).

Modifications				
Multilingual Learners	**Special Education**	**At Risk for School Failure**	**Gifted and Talented**	**504**
Scaffolding	Word walls	Teacher tutoring	Curriculum compacting	Word walls
Word walls	Visual aides	Peer tutoring	Challenge assignments	Visual aides
Sentence/paragraph frames	Graphic organizers	Study guides	Enrichment activities	Graphic organizers
Bilingual dictionaries/translation	Multimedia	Graphic organizers	Tiered activities	Multimedia
	Leveled readers	Extended time	Independent research/inquiry	Leveled readers

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

LIFE SCIENCE		
MS-LS4-4 Biological Evolution: Unity and Diversity		
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.		
Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.		
Assessment Boundary: N/A		
Evidence Statements: MS-LS4-4		
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. Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena.	**LS4.B: Natural Selection** Natural selection leads to the predominance of certain traits in a population, and the suppression of others.	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Connections to other DCIs in this grade-band: MS.LS2.A ; MS.LS3.A ; MS.LS3.B		
Articulation of DCIs across grade-bands: 3.LS3.B ; 3.LS4.B ; HS.LS2.A ; HS.LS3.B ; HS.LS4.B ; HS.LS4.C		
5E Model		
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.		
Engage Anticipatory Set	Peppered Moth Simulation http://peppermoths.weebly.com/ Peppered Moth Activity	

	http://betterlesson.com/lesson/637464/peppered-moths
Exploration Student Inquiry	What is Evolution In this activity, students will construct an explanation based on evidence that describes how genetic variation of traits in a population increase some individual's probability of surviving and reproducing in a specific environment. http://betterlesson.com/lesson/636016/what-is-evolution
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): LS4.B: Natural Selection Natural selection leads to the predominance of certain traits in a population, and the suppression of others.
Elaboration Extension Activity	Related Lessons http://betterlesson.com/next_gen_science/browse/2239/ngss-ms-ls4-6-use-mathematical-representations-to-support-explanations-of-how-natural-selection-may-lead-to-increases-and-decrea
Evaluation Assessment Tasks	Assessment Task A: Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. To end the lesson, go through Recipe For Evolution: Variation, Selection & Time which is a resource from Learn. Genetics Genetic Science Learning Center which is a wonderful resource on a large variety of biology topics. This reinforces some of the things the students should have learned by doing the simulations. To assess student learning, have students write a response to the following prompt in their journal: explain how genetic variation of traits in a population increase some individual's probability of surviving and reproducing in a specific environment. Use evidence from your investigations to support your answer. As this is a formative assessment, use a 3 point scale to assess this journal entry: 3 - Demonstrates strong understanding of the concept. 2 - Demonstrates good understanding of the concept with only minor misunderstandings 1 - Demonstrates poor understanding of the concept with major misunderstandings Meet with students who scored a 1 to ensure that their misunderstandings are cleared up before moving on to the next lesson.

LIFE SCIENCE
MS-LS4-5 Biological Evolution: Unity and Diversity
MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

Assessment Boundary: N/A

Evidence Statements: MS-LS4-5

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 experiences 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 and methods used, and describe how they are supported or not supported by evidence.	**LS4.B: Natural Selection** In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring.	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. **Connections to Engineering, Technology, and Applications of Science** **Interdependence of Science, Engineering, and Technology** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. **Connections to Nature of Science** **Science Addresses Questions About the Natural and Material World** Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

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

Articulation of DCIs across grade-bands: HS.LS3.B ; HS.LS4.C

5E Model

MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Engage Anticipatory Set	Video: Classical vs. Transgenic Breeding http://www.pbslearningmedia.org/resource/tdc02.sci.life.gen.breeding/classical-vs-transgenic-breeding/ For what kind of characteristics have food crops been selectively bred? What are some examples of harmful effects of selective breeding?
Exploration Student Inquiry	Artificially Selecting Dogs

	Students learn how artificial selection can be used to develop new dog breeds with characteristics that make the dogs capable of performing a desirable task. Students begin by examining canine features and their functions. They are then given a scenario that describes the type of task they need a new breed of dog to perform. They then select two existing breeds they feel will most likely produce a successful new breed and determine the resulting offspring's characteristics. This lesson emphasizes variation, inheritance, selection, and time (number of generations) to help students develop a clear understanding of artificial selection and, ultimately, natural selection. http://www.ucmp.berkeley.edu/education/lessons/breeding_dogs/ Genetic Technology Students will conduct research to determine the similarities, differences , applications and potential impacts of genetic technologies. http://betterlesson.com/lesson/636020/genetic-technology
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): LS4.B: Natural Selection In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring.
Elaboration Extension Activity	Genetic Engineering Debate Objective: To research the genetic engineering of food and create a public service announcement from the perspective of either the farmer or consumer. Questions for students to address: What type of technology is used in your type of genetic engineering? What are the benefits and risks of this type of technology? Who should be in charge of regulating and monitoring this type of genetic engineering to make sure that no one is abusing this technology? Research- positions must be based on facts
Evaluation Assessment Tasks	Assessment Task A: Artificially Selecting Dogs- Written Response Following this activity, students will write a paragraph describing the process of artificial selection in their own words, using dogs or another organism as their example. Encourage students to use and underline the VIST terms (variation, inheritance, selection, time) in their explanation. Assessment Task B: Clone Video Reflection Following the activity part of the Genetic Technology lesson, students should synthesize information learned by completing the reflection activity.

	Assessment Task C: Students will create an illustration that sums up their feelings/viewpoint on the genetic technologies they just learned about. Students can hand draw this or create it on the computer but either way it must be neat, colorful and their position (for or against) must be obvious. Students can then compare their wordle created in the warm-up to their illustration to see if their perspective has changed. 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.

LIFE SCIENCE		
MS-LS4-6 Biological Evolution: Unity and Diversity		
MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.		
Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.		
Assessment Boundary: Assessment does not include Hardy Weinberg calculations.		
Evidence Statements: MS-LS4-6		
Science & Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to support scientific conclusions and design solutions.	**LS4.C: Adaptation** Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Connections to other DCIs in this grade-band: MS.LS2.A ; MS.LS2.C ; MS.LS3.B ; MS.ESS1.C		
Articulation of DCIs across grade-bands: 3.LS4.C ; HS.LS2.A ; HS.LS2.C ; HS.LS3.B ; HS.LS4.B ; HS.LS4.C		

5E Model	
MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	
Engage Anticipatory Set	Natural Selection Video http://www.hhmi.org/biointeractive/making-fittest-natural-selection-and-adaptation
Exploration Student Inquiry	Nature at Work Mice Lab https://d2ct263enury6r.cloudfront.net/dQOQjAOu34mWuVJ625rTV9mYLbqflasfeqyDrQZten4WDa0h.pdf

	If the events in the game occurred in nature, how would the group of mice change over time? How did the results for the white sand environment differ from those of the brown forest floor environment? Students should use their numerical data to explain how natural selection leads to increases or decreases of specific traits in populations over time.
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): LS4.C: Adaptation Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.
Elaboration Extension Activity	Related Lessons http://betterlesson.com/next_gen_science/browse/2239/ngss-ms-ls4-6-use-mathematical-representations-to-support-explanations-of-how-natural-selection-may-lead-to-increases-and-decrea
Evaluation Assessment Tasks	Assessment Task A: Lab Analysis Questions Assessment Task B: Lab Graph Use mathematical representations to support scientific conclusions and design solutions. Student graphs should: - compare the population changes of mice in both environments across all three generations - include a title, labels and a key if necessary

Unit 3: Overview
Unit 3: Stability and Change on Earth
Grade: 8
Content Area: Earth and Space Science
Pacing: 30 Instructional Days
Essential Question
Why aren't minerals and groundwater distributed evenly across the world?
Student Learning Objectives (Performance Expectations)
MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused [rise in global temperatures] climate change over the past century.

Unit Summary

Students construct an understanding of the ways that human activities affect Earth's systems. Students use practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts on the development of these resources. Students also understand that the distribution of these resources is uneven due to past and current geosciences processes or removal by humans. The crosscutting concepts of patterns, cause and effect, and stability and change are called out as organizing concepts for these disciplinary core ideas. In this unit of study students are expected to demonstrate proficiency in asking questions, analyzing and interpreting data, constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Technical Terms

non-renewable, petroleum,organic marine sediment, geological traps , metal ores, hydrothermal, subduction zones, geoscience process, natural hazards, catastrophic events, mass wasting, per-capita consumption, solar radiation, methane, carbon dioxide

Formative Assessment Measures

Part A: Why aren't minerals and groundwater distributed evenly across the world?

Students who understand the concepts are able to:

Construct a scientific explanation based on valid and reliable evidence of how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geosciences processes.

Obtain evidence from sources, which must include the student's own experiments.

Construct a scientific explanation based on the assumption that theories and laws that describe the current geosciences process operates today as they did in the past and will continue to do so in the future.

Part B: How can we predict and prepare for natural disasters?

Students who understand the concepts are able to:

Analyze and interpret data on natural hazards to determine similarities and differences and to distinguish between correlation and causation.

Part C: How might we treat resources if we thought about the Earth as a spaceship on an extended survey of the solar system?

Students who understand the concepts are able to:

Construct an oral and written argument 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.

Interdisciplinary Connections

NJSLS- ELA	NJSLS- Mathematics
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant	8.EE.C.8.c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

evidence is introduced W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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. SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	
Core Instructional Materials	Textbooks Series, Lab Materials, etc.
Career Readiness, Life Literacies and Key Skills	9.4.8.CI.1 Assess data gathered on varying perspectives or causes of climate change (crosscultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions. 9.4.8.CI.2 Repurpose an existing resource in an innovative way 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.. 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.8 Explain how communities use data and technology to develop measures to respond to effects of climate change.

	9.4.8.GCA.2 Demonstrate openness to diverse ideas and perspectives through active discussion to achieve a group goal. 9.4.8.IML.1 Critically curate multiple resources to assess the credibility of sources when researching for information. 9.4.8.IML.8Apply deliberate and thoughtful search strategies to access high-quality information on climate change. 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.4 Synthesize and publish information about a local or global issue or event. 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.3 Develop a proposal for a solution to a real-world problem that includes a model. 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.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.ETW.3 Analyze the design of a product that negatively impacts the environment or society and 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				
Multilingual Learners	**Special Education**	**At Risk for School Failure**	**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

EARTH AND SPACE SCIENCE
MS-ESS3-1 Earth and Human Activity

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).

Assessment Boundary: N/A

Evidence Statements: MS-ESS3-1

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 with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	**ESS3.A: Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Connections to Engineering, Technology, and Applications of Science** **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.

Connections to other DCIs in this grade-band: MS.PS1.A ; MS.PS1.B ; MS.ESS2.D

Articulation of DCIs across grade-bands: 4.PS3.D ; 4.ESS3.A ; HS.PS3.B ; HS.LS1.C ; HS.ESS2.A ; HS.ESS2.B ; HS.ESS2.C ; HS.ESS3.A

5E Model

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Engage Anticipatory Set	Video: Groundwater, Beneath the Surface http://science.kqed.org/quest/2014/03/26/groundwater-beneath-the-surface/ Pre-Discussion Questions What is water called beneath the surface? What are some dangers facing aquifers and groundwater? Post-Discussion Questions: Why is groundwater so vital to us?

	How does the water cycle operate? Extension Activity Name as many parts of the water cycle as you can and describe the function of each. Possible activity: Draw a water cycle with as many parts as you can to show how they all interact, and then replay the animation to check and fill in the rest. Compare groundwater to aquifers. How are they alike and how are they different? How are aquifers replenished or depleted?
Exploration Student Inquiry	Students will work in pairs at computer stations on the "Energy in the U.S. Webquest". Students will learn about renewable and nonrenewable energy sources and current and future consumption trends in the U.S. Students will need to utilize headphones during the video/audio sections of the Webquest in order to successfully complete it. When students complete the Webquest, the teacher will initiate a class discussion using the following discussion questions: 1. What agencies or organizations sponsored the Web sites you collected information from and what might their bias be? 2. Do you think the information presented on the Web sites is balanced? 3. What makes some energy sources renewable and others nonrenewable? 4. What are the advantages of using renewable energy sources? 5. Do you think the U.S. has an obligation to reduce its use of nonrenewable energy sources? Why? 6. What future energy trends do you think are likely for the U.S.? For more explicit teacher instructions visit http://sfrc.ufl.edu/extension/ee/woodenergy/files/activities/WoodEnergy_activity1.pdf After completing this Webquest, ask students to create a poster using the information they collected about energy in the U.S. The overarching topic of the poster can be open to students. For example, it could focus on renewable energy, impacts of energy on the environment, trends in U.S. energy consumption, or a comparison of U.S. energy consumption to other countries. Students should use graphics or pictures. Encourage students to draw or use magazine clippings or photos and to be as creative as possible. Students should also cite evidence and resources from the Web-quest in the poster text. Posters can be displayed around the classroom, lunchroom, or in school hallways.
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. ESS3.A: Natural Resources Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.
Elaboration Extension Activity	Extension Activities: Better Lessons (MS-ESS3-1) Measuring Energy in the Atmosphere: Exploring Climate Change What Are Fossil Fuels? Blame it on the Carbon Energy History

	Why is Coal So Important? Exploring Oil What are We Coming Home To?
Evaluation Assessment Tasks	Assessment Task A: Student Poster Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Following the WebQuest, students will use the information they gathered to create a poster. Student posters should include a scientific explanation which focuses on how the availability of nonrenewable energy resources has and continues to change. See Rubric on pg. 4 http://sfrc.ufl.edu/extension/ee/woodenergy/files/activities/WoodEnergy_activity1.pdf

EARTH AND SPACE SCIENCE		
MS-ESS3-2 Earth and Human Activity		
MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.		
Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and without notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).		
Assessment Boundary: N/A		
Evidence Statements: MS-ESS3-2		
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.	**ESS3.B: Natural Hazards** Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	**Patterns** Graphs, charts, and images can be used to identify patterns in data. **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. Thus technology use varies from region to region and over time.
Connections to other DCIs in this grade-band: MS.PS3.C		
Articulation of DCIs across grade-bands: 3.ESS3.B ; 4.ESS3.B ; HS.ESS2.B ; HS.ESS2.D ; HS.ESS3.B ; HS.ESS3.D		
5E Model		
MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.		
Engage Anticipatory Set	Have students view series of National Geographic Videos on Catastrophic Events (volcanoes, hurricanes, tsunamis, tornadoes, and earthquakes. http://video.nationalgeographic.com/video/environment Lead classroom discussion on catastrophic events. Encourage students to share their previous understanding of and personal experiences with these events.	
Exploration Student Inquiry	Naturally Disastrous In this lesson, students are introduced to natural disasters and learn the difference between natural hazards and natural disasters. They discover the many types of natural hazards—avalanche, earthquake, flood, forest fire, hurricane, landslide, thunderstorm, tornado, tsunami and volcano—as well as specific examples of natural disasters. Students also explore why understanding these natural hazards is important to survival on our planet. https://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_natdis/cub_natdis_lesson01.xml Save Our City In this lesson, students learn about various natural hazards and specific methods engineers use to prevent these hazards from becoming natural disasters. They study a hypothetical map of an area covered with natural hazards and decide where to place natural disaster prevention devices by applying their critical thinking skills and an understanding of the causes of natural disasters. https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_natdis/cub_natdis_lesson01_activity1.xm	
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. ESS3.B: Natural Hazards Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.	
Elaboration Extension Activity	Earthquake Hazards http://betterlesson.com/lesson/629624/earthquake-hazards In this activity, students will identify major seismic hazards and evaluate the effectiveness of various safety measures.	
Evaluation Assessment Tasks	Predicting Volcanic Eruptions: Exercise Analyze and interpret data to determine similarities and differences in findings.	

	Students will apply their understanding of interpreting natural hazard data to forecast future catastrophic events.

EARTH AND SPACE SCIENCE

MS-ESS3-4 Earth and Human Activity

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.

Assessment Boundary: N/A

Evidence Statements: MS-ESS3-4

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(s). Construct an oral and written argument 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.	**ESS3.C: Human Impacts on Earth Systems** Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. **Connections to Engineering, Technology, and Applications of Science** **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. **Connections to Nature of Science** **Science Addresses Questions About the Natural and Material World** Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.

Connections to other DCIs in this grade-band: MS.LS2.A ; MS.LS4.D

Articulation of DCIs across grade-bands: 3.LS2.C ; 3.LS4.D ; 5.ESS3.C ; HS.LS2.A ; HS.LS2.C ; HS.LS4.C ; HS.LS4.D ; HS.ESS2.E ; HS.ESS3.A ; HS.ESS3.C

5E Model

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Engage Anticipatory Set	Have students view the following videos then lead a class discussion on the rate of human population growth and the effect this is having on natural resources : 7 Billion: How Did We Get So Big So Fast? http://www.npr.org/2011/10/31/141816460/visualizing-how-a-population-grows-to-7-billion

	Are We Using Up More Than What Is Available? http://www.theworldcounts.com/stories/consequences_of_depletion_of_natural_resources Video: Sustainable Development within Environmental Limits http://study.com/academy/lesson/sustainable-development-within-environmental-limits.html
Exploration Student Inquiry	Why Do We Build Dams? In this activity, students will be introduced to the concept of a dam and its potential benefits, which include water supply, electricity generation, flood control, recreation and irrigation. This lesson begins an ongoing classroom scenario in which student engineering teams working for the Splash Engineering firm design dams for a fictitious client, Thirsty County. https://www.teachengineering.org/view_lesson.php?url=collection/cub_/lessons/cub_dams/cub_dams_lesson01.xml How Much Water Do You Use? In this activity, students will keep track of their own water usage for one week, gaining an understanding of how much water is used for various everyday activities. Students will then relate their own water usages to the average residents of imaginary Thirsty County, and calculate the necessary water capacity of a dam that would provide residential water to the community. https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_dams/cub_dams_lesson01_activity1.x Following these activities, students will be asked to synthesize their understanding of this concept by constructing an argument that explains the connection between human population and the availability of natural resources. Students should refer to concrete examples from these activities in order to support their argument with evidence.
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. ESS3.C: Human Impacts on Earth Systems Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
Elaboration Extension Activity	Related Activities Earth Science Week: MS-ESS3-4 http://www.earthsciweek.org/ngss-performance-expectations/ms-ess3-4
Evaluation Assessment Tasks	Assessment Task A: Why Do We Build Dams? Proposal Construct an oral and written argument 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. After you have introduced the hypothetical Thirsty County scenario, divide the class into engineering teams of 2-3 students each, and ask each team to write a short proposal response to the municipality of Thirsty County to address the resident's' needs. Proposals should comment on the needs of the residents, some possible solutions (at least a Plan A and Plan B), and benefits/problems associated with each plan proposed. For example, students may write a statement that says their team will "address the resident's' needs by designing a dam that provides people with water during summer droughts, protects buildings from flash floods and storms, and produces hydropower as a clean energy alternative to coal-fired power plants.

EARTH AND SPACE SCIENCE		
MS-ESS3-5 Earth and Human Activity		
MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused [rise in global temperatures] climate change over the past century.		
Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.		
Assessment Boundary: N/A		
Evidence Statements: MS-ESS3-5		
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. Ask questions to identify and clarify evidence of an argument.	**ESS3.D: Global Climate Change** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	**Stability and Change** Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
Connections to other DCIs in this grade-band: MS.PS3.A		
Articulation of DCIs across grade-bands: HS.PS3.B ; HS.PS4.B ; HS.ESS2.A ; HS.ESS2.D ; HS.ESS3.C ; HS.ESS3.D		
5E Model		
MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.		
Engage Anticipatory Set	Show the trailer for the movie "Chasing Ice". Have students work in small groups or pairs to try and identify themes or ideas conveyed by the trailer. https://chasingice.com/ Have students read the online National Geographic article "The Big Thaw". The article explores the issues around global warming and melting glaciers. View and discuss each photo from the photo gallery. http://ngm.nationalgeographic.com/2007/06/big-thaw/big-thaw-text Show students a graph of the increase in average temperature on Earth over the last few years. Have students examine the graph and make hypotheses about why the temperature has increased. http://climate.nasa.gov/vital-signs/global-temperature/	
Exploration Student Inquiry	Activity 1: Exploring Global Climate Change Have students view the video Global Warming 101. After viewing the video, lead a brief discussion about the facts presented. http://video.nationalgeographic.com/video/101-videos/global-warming-101.	

	Allow students to view the National Geographic site on Global Warming http://environment.nationalgeographic.com/environment/global-warming/ Next, student will explore NASA's climate change website: On this site, students can view facts, explore interactive features, view videos, read articles related to climate change, providing them with a basis of understanding on this topic. http://climate.nasa.gov/. After exploring the site, direct students to NASA's whiteboard animation series. Guide students in viewing and discussion several of these video animations. Following each video, lead students in a discussion to assess their thoughts and reactions. http://climate.nasa.gov/climate_resource_center/earthminute Climate Hot Map http://www.climatehotmap.org/index.html Activity 2: Viewpoints on Global Warming To expose students to opposing viewpoints on global warming, have students read the article: Is Global Warming Real? This article presents the five top arguments both for and against global warming. http://www.conserve-energy-future.com/is-global-warming-real.php After reading this article, have students complete the Venn-Diagram to answer the question: Has human activity caused the world's climate to change over the past 100 years? Have students discuss their completed diagrams. What were some of the similarities and differences among the completed Venn-Diagrams? http://www-tc.pbs.org/now/classroom/globalvenn.pdf Activity 3: Making Predictions About the Effects of Global Warming With a basic understanding of the global climate change, students can now make predictions about the potential impact of global warming. Ask students to hypothesize about how the world's climate could change over the next 100 years if humans do not take action. Have students make predictions about the effects such climate changes could have on humans. Have students explore NASA proposed solutions to climate change, specifically proposed energy innovations. In groups, have students visit the following website and select one of the innovations. Students should read the article on their chosen innovation and gather key facts. Have students share these facts through brief group presentations. http://climate.nasa.gov/solutions/energy_innovations/
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. ESS3.D: Global Climate Change Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.
Elaboration Extension Activity	Global Warming Project (PBS) http://www-tc.pbs.org/now/classroom/globalproject.pdf
Evaluation	Assessment Task A: Question Debate

Assessment Tasks	Ask questions to identify and clarify evidence of an argument. Following Activity 2- Viewpoints on Global Warming, students will be asked to pick a position on the topic of global warming. Using the evidence they gathered for both positions on their Venn-Diagram, the students will then be asked to construct a series of questions that could be used in a class debate on the topic. The questions that the students formulate should be directed to those who identify with the opposing view. Students will be assessed on the quality of the questions they develop and their overall participation in the debate.

Unit 4: Overview
Unit 4: Human Impacts
Grade: 8
Content Area: Earth and Space Science
Pacing: 25 Instructional Day
Essential Questions
How do we monitor the health of the environment (our life support system)? Is it possible to predict and protect ourselves from natural hazards?
Student Learning Objectives (Performance Expectations)
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
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.
Unit Summary
In this unit of study, students analyze and interpret data and design solutions to build on their understanding of the ways that human activities affect Earth's systems. The emphasis of this unit is the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of these uses. The crosscutting concepts of cause and effect and the influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Building on Unit 3, students define a problem by precisely specifying criteria and constraints for solutions as well as potential impacts on society and the natural environment; systematically evaluate alternative solutions; analyze data from tests of different solutions; combining the best ideas into an improved solution; and develop and iteratively test and improve their model to reach an optimal solution.In this unit of study students are expected to demonstrate proficiency in analyzing and interpreting data and designing solutions.Students are also expected to use these practices to demonstrate understanding of the core ideas.
Technical Terms
Aquifers, levee, urban development, pollution, anthropogenic, particulates, ecological community
Formative Assessment Measures
Part A: How do we monitor the health of the environment (our life support system)?
Students who understand the concepts are able to: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Interdisciplinary Connections	
NJSLS- ELA	**NJSLS- Mathematics**
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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. SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence,	8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways 8.EE.C.8.c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair. 8.EE.B.6 Understand the connections between proportional relationships, lines, and linear equations: Use similar triangles to explain why the slope is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation for a line through the origin and the equation for a line intercepting the vertical axis at

sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	
Core Instructional Materials	Textbooks Series, Lab Materials, etc.
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. 9.4.8.CI.2 Repurpose an existing resource in an innovative way. 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 a climate change, and use critical thinking skills to predict which one(s) are likely to be effective. 9.4.8.CT.2 Develop multiple solutions to a problem an evaluate short- and long-term effects to determine the most plausible option, 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.8 Explain how communities use data and technology to develop measures to respond to effects of climate change. 9.4.8.IML.5 Analyze and interpret local or public dataset to summarize and effectively communicate data. 9.4.8.IML.8 Apply deliberate and thoughtful search strategies to access high-quality information on climate change. 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.4 Synthesize and publish information about a local or global issue or event. 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.1Organize 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.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.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.ETW.2 Analyze the impact of modifying resources in a product or system. 8.2.8.ETW.3 Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen the 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				
Multilingual Learners	**Special Education**	**At Risk for School Failure**	**Gifted and Talented**	**504**
Scaffolding	Word walls	Teacher tutoring	Curriculum compacting	Word walls
Word walls	Visual aides	Peer tutoring	Challenge assignments	Visual aides
Sentence/paragraph frames	Graphic organizers	Study guides	Enrichment activities	Graphic organizers
Bilingual	Multimedia	Graphic organizers	Tiered activities	Multimedia

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

EARTH AND SPACE SCIENCE		
MS-ESS3-3 Earth and Human Activity		
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.		
Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).		
Assessment Boundary: N/A		
Evidence Statements: MS-ESS3-3		
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 principles to design an object, tool, process or system.	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **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. Thus technology use varies from region to region and over time.

Connections to other DCIs in this grade-band: MS.LS2.A ; MS.LS2.C , MS.LS4.D	
Articulation of DCIs across grade-bands: 3.LS2.C ; 3.LS4.D ; 5.ESS3.C ; HS.LS2.C ; HS.LS4.C ; HS.LS4.D ; HS.ESS2.C ; HS.ESS2.D ; HS.ESS2.E ; HS.ESS3.C ; HS.ESS3.D	
5E Model	
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	
Engage Anticipatory Set	Have students view the following video and online quiz Human Impact on the Environment: http://study.com/academy/lesson/human-impacts-on-the-environment.html
Exploration Student Inquiry	Will the Air Be Clean Enough to Breath? This online interactive is comprised of five modules. In completing these activities, students will explore real-time air quality data with maps from the United States EPA. They will run experiments with computational models to investigate how pollutants flow in the atmosphere and look at how factors such as wind, sun, rain, geography and pollution affect air quality. By the end of the module, students will be able to predict the effect of human development on a region's future air quality. http://concord.org/stem-resources/will-air-be-clean-enough-breathe Design Your Society In this activity, students will use all they have learned about the potential impacts of climate change to create a 3D model of a self-sustaining, resilient society. http://betterlesson.com/lesson/644797/design-your-society
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. ESS3.C: Human Impacts on Earth Systems Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
Elaboration Extension Activity	Mix and Math Ecology: Human Impact Challenge students to think of a way to reduce the threat to the natural resource of their mix-and-match combinations without eliminating the human action. http://www.learnnc.org/lp/media/uploads/2008/12/ecologyworksheet.pdf In what ways could the human action be changed to achieve the same result but with better environmental consequences? Could any buffers or protection be placed on the ecological communities that might better preserve the natural resource? What policies or laws could be passed that might help?
Evaluation	Assessment Task A: Design Your Society using Google Sketch Up

Assessment Tasks	Apply scientific principles to design an object, tool, process or system. Using what students have learned about the potential impacts of climate change, students will create a 3D model of a self-sustaining, resilient society (using Google Sketch Up). Assessment Task B: Society Presentations Students will present 3D models to the class. Students viewing the presentations will use the Society Presentation Notes Guide to synthesize and interpret information learned from presentations.

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		

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	ETS1.B: Developing Possible Solutions	

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.	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		

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		

Unit 5: Overview
Unit 5: 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?

Students who understand the concepts are able to:

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
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in	8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. 8.EE.A.2 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 $\sqrt{2}$ is irrational.

a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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. SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	8.F.A.3 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.

Core Instructional Materials	Textbooks Series, Lab Materials, etc.
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	8.1.8.DA.1 Organiza and transform data collected using computational tools to make it usable for a specific purpose.

Thinking	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				
Multilingual Learners	**Special Education**	**At Risk for School Failure**	**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	
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 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 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, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms.	**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.	**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 other DCIs in this grade-band: N/A

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

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. **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	**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 other DCIs in this grade-band: MS.PS2.A		
Articulation of DCIs across grade-bands: 4.PS3.C ; HS.PS3.A ; HS.PS3.B		
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 6: Overview
Unit 6: 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?
Students who understand the concepts are able to: 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).
Students who understand the concepts are able to: 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**
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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. SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence,	8.EE.C.8.c. Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	
Core Instructional Materials	Textbooks Series, Lab Materials, etc.
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.DA1 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.ETW.2 Analyze the impact of modifying resources in a product or system.

Modifications

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

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		

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		

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

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 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.	**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**	**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.

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	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.	
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		

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	Related Activities

Extension Activity	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		

Unit 7: Overview
Unit 7: 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:
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.

Interdisciplinary Connections

NJSLS- ELA	NJSLS- Mathematics
RL.CR.8.1. Cite a range of textual evidence and make clear and relevant connections to strongly support an analysis of multiple aspects of what a literary text says explicitly as well as inferences drawn from the text. RI.AA.8.7. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced	8.EE.B.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed

W.AW.8.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence W.IW.8.2. Write informative/explanatory texts (including the narration of historical events, scientific procedures/ experiments, or technical processes) to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. W.WR.8.5. 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. SL.PE.8.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly SL.PI.8.4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciationtion, strengthen claims and evidence, and add interest.	
Core Instructional Materials	Textbooks Series, Lab Materials, etc.
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.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.
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				
Multilingual Learners	**Special Education**	**At Risk for School Failure**	**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	**PS4.A: Wave Properties**	**Patterns**

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.	A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	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		
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		

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 and visual displays to clarify claims and findings.	**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.

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

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.