MIDDLE SCHOOL

SCIENCE CURRICULUM

Middle Township Public Schools

216 S. Main Street

Cape May Court House, NJ 08210

Born: August 2016 Revised: 2022

Middle Township

Middle School

6th Grade

Science

Curriculum

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PHILOSOPHY AND GOALS

This document serves to meet all requirements for curriculum as per the Middle Township Board of Education and the New Jersey Department of Education and will serve as a guide for lesson planning. Units within the curricular framework for science are designed to be taught in the order in which they are presented. Within the units, the teachers have flexibility of what order to present the standards. Suggested Science and Engineering Practice Standards and Cross-Cutting Concepts are listed in each unit to be embedded regularly in daily science instruction.

Middle School science in Middle Township Public School district is interdisciplinary and covers all four domains of the Next Generation Science Standards: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science. The goal of science education curriculum is to produce students who have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives. They should come to appreciate that science and the current scientific understanding of the world are the result of many hundreds of years of creative human endeavor. It is especially important to note that the above goals are for all students, not just those who pursue careers in science, engineering, or technology or those who continue on to higher education (p. 9, NRC, 2012).

Given this goal, an integrated science curriculum model should drive the formation of middle school science curriculum because:

- The nature of science is complex and multidisciplinary.
- Learning theory research in science shows expert knowledge base develops better through interdisciplinary connections and not through isolated content.
- Effective research-based practices for curriculum and instruction in science and engineering are supported through this approach.

The nature of science is complex and multidisciplinary. From research about how scientists work, we know that scientists do not work in isolation in their own house of physics, or biology or chemistry but they reach out and create networks of scientists within and across disciplines who can contribute understanding, share ideas, and critique evidence and explanations. As we see in the science of global climate change, scientists work across the fields of geology, physics, and biology to provide evidence, plan investigations, and develop models to represent new ways to think about Earth systems. Important practices like engaging in argument from evidence, modeling, and communicating information do not occur in isolation but rely on feedback from within and across scientific communities and disciplines. Basing the middle school model curriculum in an integrated model where the students are engaged with a variety of topics at each grade, focused on the connection of ideas across the domains, enhances the interdisciplinary nature of science.

In the elementary years, students build their understanding of core concepts across all three domains of science: Physical, Life, Earth and Space. Continuing this model in grades 6-8 better supports student learning in that there will not be a large gap of time in which a student does not engage in a specific discipline. This model takes advantage of current research which recognizes that there is variation across children at a given age and that thinking does not develop along a preset roadmap for each student. It allows middle school students to build on what they know and think they understand from their elementary years with the goal in middle school of helping students to revise their knowledge and understanding about those core ideas. Learning theory research shows expert knowledge base develops better through interdisciplinary real-world connections than through isolated content. This is especially important in middle school where motivation is critical to learning. An integrated and better articulated middle school model science curriculum that reflects what we know currently about how children learn science and how their mastery develops over time promotes deeper learning in science. As we know and understand about how students develop understanding while learning content, it informs teachers' practice; if teachers understand where their students are in their understanding of core ideas, and anticipate what students' misconceptions and struggles may be, they are better able to differentiate instruction and provide scaffolding that allows students to develop an integrated and deeper understanding of the science.

DIVERSITY AND INCLUSION

In alignment with the New Jersey Student Learning Standards, the Science curriculum materials will:

- Cultivate respect towards minority groups to foster appreciation of their differences as well as recognizing their contributions to the advancement of science and technology.

- Evaluate experiences of people of diverse backgrounds and their unique journeys, including challenges and successes, and their significant historic contributions to the scientific, economic, political, and social development of New Jersey and the United States.

- Analyze grade-level texts highlighting the technological and scientific contributions of persons of different genders, ethnicities, and abilities.

- Apply the critical thinking process to develop empathy, challenging biases, to better understand different perspectives and experiences to creatively problem-solve and innovate solutions for diverse groups of people with specific needs.

- Engage in authentic learning experiences that enable students to acquire and incorporate varied perspectives, and to communicate with diverse audiences while applying content knowledge, integrating concepts across disciplines, and developing scientific thinking skills.

- Participate in an inclusive and diverse scientific culture that appreciates and incorporates perspectives from people of different genders, ethnicities, and abilities.

- Understand how scientific, economic, political, social, and cultural aspects of society drive development of new scientific and technological products, processes, and systems.

● Reflect on personal experiences and the experiences of others building empathy and promoting a climate of respect and acceptance of people with different backgrounds and abilities.

Three Dimensions of the Next Generation Science Standards

The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence- based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires.

Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and function; Stability and change. The Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.

Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
- Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
- Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;
- Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

6th Grade Earth Science and Pacing Guide			
Unit of Study	**Concepts**	**NGSS**	**Instructional Days**
Unit 1- Atmosphere and Weather	A: Atmosphere B: Predicting Weather C: Severe Weather	MS-ES2-5 MS-ES2-6 MS-ES3-2 MS-ETS1-3	30
Unit 2- Climate and Human Impact	A: Climate B: Climate Change	MS-ES3-1 MS-ES3-3	25

	C: Human Impact	MS-ES3-4 MS-ES3-5 MS-ETS1-1	
Unit 3- Earth's Systems	A: Minerals and Rocks in the Geosphere B: Plate Tectonics C: Earth's Systems	MS-ES2-1 MS-ES2-2 MS-ES2-3 MS-ES2-4	30
Unit 4- Earth's 4.6 Billion Year History	A: Geological Time Scale B: Fossils	MS-ES1-4 MS-LS4-1 MS-LS4-2 MS-LS4-3	25
Unit 5- Astronomy	A: Earth, Sun and Moon Systems B: Our Solar System C: The Universe	MS-ES1-1 MS-ES1-2 MS-ES1-3	35

Unit 1: Atmosphere and Weather

Instructional Days: 30

Unit Summary
This unit is broken down into three sub-ideas: Earth's large-scale systems interactions, the roles of water in Earth's surface processes, and weather. Students make sense of how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. A systems approach is also important here, examining the feedbacks between systems as energy from the Sun is transferred between systems and circulates through the ocean and atmosphere. The crosscutting concepts of cause and effect, systems and system models, and energy and matter are called out as frameworks for understanding the disciplinary core ideas. In this unit, students are expected to demonstrate proficiency in developing and using models and planning and carrying out investigations as they make sense of the disciplinary core ideas. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-ES2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
MS-ES2-6	Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
MS-ES3-2	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics and differences of each that can be combined into a new solution to better meet the criteria for success.

Unit Sequence and Pacing: Unit 1- Atmosphere & Weather		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A : Atmosphere ● Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. ● Global movements of water and its changes in form are propelled by sunlight and gravity. ● The cycling of water through Earth's systems is driven by energy from the sun and the force of gravity. ● Within Earth's systems, the transfer of energy drives the motion and/or cycling of water.	Students who understand the concepts are able to: ● Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. ● List the composition and structure of the Earth's atmosphere ● Explain how energy from the sun affects Earth's atmosphere ● Conclude how the sun's energy reaches and move through the Earth's atmosphere ● Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Making Drops of Rain ● River Erosion ● Demonstrating That Air Has Mass ● Slowing Evaporation ● Comparing the Weather
Topic B: Predicting Weather ● The motions and complex interactions of air masses result in changes in weather conditions. ● The complex patterns of the changes in and movement of water in the atmosphere, determined by winds, landforms, and ocean	Students who understand the concepts are able to: ● Explain how global patterns affect air masses and how the air masses interact to form fronts. ● Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather	● Air Masses Stations ● Predicting Weather - Weather map practice ● Types of Weather Fronts Labs

temperatures and currents, are major determinants of local weather patterns. ● Examples of data that can be used to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions include weather maps, diagrams, and visualizations; other examples can be obtained through laboratory experiments. ● Air masses flow from regions of high pressure to regions of low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time. Because patterns of the changes and the movement of water in the atmosphere are so complex, weather can only be predicted probabilistically. Sudden changes in weather can result when different air masses collide. Weather can be predicted within probabilistic ranges. Cause-and effect-relationships may be used to predict changes in weather.	conditions ● Infer how meteorologists use the interactions of air masses to forecast changes in weather ● Use a weather map to help model current weather and predict future weather Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic C: Severe Weather ● Natural hazards can be the result of interior processes, surface processes, or severe weather events. ● Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for	Students who understand these concepts are able to: ● Discover how severe weather affects human life	● Hurricane Gizmo ● Severe Weather Preparation Plan

reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. ● 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. ● Data on natural hazards can be used to forecast future catastrophic events and inform the development of technologies to mitigate their effects. ● Data on natural hazards can include the locations, magnitudes, and frequencies of the natural hazards. ● Graphs, charts, and images can be used to identify patterns of natural hazards in a region. ● Graphs, charts, and images can be used to understand patterns of geologic forces that can help forecast the locations and likelihoods of future events. ● Technologies that can be used to mitigate the effects of natural hazards can be global or local.	Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	

Sample of Open Education Resources

Air Masses Students learn about the four main types of air masses that affect weather in the United States, their characteristic temperatures, and humidity levels as it relates to dew point temperatures. The lesson plan follows the 5E format. Students learn about the source regions of air masses and compare their maps to a forecast weather map with fronts and pressure systems drawn in.

Air Mass Extension Students try to identify locations of air masses. They sketch in fronts and compare their results to the fronts map.

Ocean Currents and Sea Surface Temperature allows students to gather data using My NASA Data microsets to investigate how differential heating of Earth results in circulation patterns in the oceans and the atmosphere that globally distribute the heat. They examine the relationship between the rotation of Earth and the circular motions of ocean currents and air. Students also make predictions based on the data to concerns about global climate change.

Adopt a Drifter: Do Ocean Surface Currents Influence Climate? Students construct climagraphs showing both precipitation and temperature for 3 coastal cities and describe how ocean surface currents affect climate on nearby land. They are provided with the research question, “Do ocean currents influence climate?” and are asked to construct a hypothesis. The activity should take 2 class periods.

Textbooks used but not limited to:

Pearson Realize Elevate

Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-1: Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables and clarifying arguments and models. ● Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5) **SEP-2: Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising	**ESS2.C: The Roles of Water in Earth's Surface Processes** ● The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5) ● Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)	**CCC-2: Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) **CCC-4: Systems and System Models** ● Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

models to describe, test, and predict more abstract phenomena and design systems. ● Develop and use a model to describe phenomena. (MS-ESS2-6) **SEP-3: Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ● Collect data about the performance of a proposed object, tool, process, or system under a range of conditions. (MS-ESS2-5)	**ESS2.D: Weather** ● Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS- ESS2-6) ● Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) ● The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)	**CCC- 7: Stability and Change** ● Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

Technology Standard(s)
8.1.8.E.1 Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem. **8.2.8.D.1** Design and create a product that addresses a real world problem using a design process under specific constraints. **8.2.8.D.2** Identify the design constraints and trade-offs involved in designing a prototype (e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook. **8.2.8.D.3** Build a prototype that meets a STEM-based design challenge using science

Interdisciplinary Standard(s)	
ELA/Literacy ● **RI.3.1** - Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-ESS2- 2), (3-ESS3-1) ● **RI.3.9** - Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2) ● **W.3.1** - Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1) ● **W.3.7** - Conduct short research projects that build knowledge about a topic.(3-ESS3-1) ● **W.3.8** - Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-ESS2-2)	**Mathematics** ● **3.MD.A.2** - Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-ESS2-1) ● **3.MD.B.3** - Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. (3-ESS2-1) ● **MP.2** - Reason abstractly and quantitatively. (3-ESS2-1), (3-ESS2-2), (3-ESS3-1) ● **MP.4** - Model with mathematics. (3-ESS2-1), (3-ESS2-2), (3-ESS3-1) ● **MP.5** - Use appropriate tools strategically. (3-ESS2-1)

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
		CRP1. Act as a responsible and contributing citizen and employee
	E	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E	**CRP4. Communicate clearly and effectively with reason**

	T	**CRP5. Consider the environmental, social and economic impacts of decisions**
		CRP6. Demonstrate creativity and innovation
		CRP7. Employ valid and reliable research strategies
	E	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
	E	**CRP10. Plan education and career paths aligned to personal goals**
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E**	**Creativity and Innovation**
	X	**Health Literacy**		**E,T**	**Collaboration, Teamwork and Leadership**
		Civic Literacy			**Cross-Cultural and Interpersonal Communication**

		Financial, Economic, Business and		**E,A**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 2: Climate and Human Impact

Instructional Day: 25

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.

Student Learning Objectives	
MS-ES3-1	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-ES3-3	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
MS-ES3-4	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS-ES3-5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
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 Sequence and Pacing: Unit 2- Climate & Human Impact		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Climate ● Unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. ● Patterns of atmospheric and oceanic circulation that determine regional climates vary by latitude, altitude, and geographic land distribution. ● Atmospheric circulation that, in part, determines regional climates is the result of sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds. ● Ocean circulation that, in part, determines regional climates is the result of the transfer of heat by the global ocean convection cycle, which is constrained by the	Students who understand the concepts are able to: ● Compare and contrast weather and climate ● Describe how latitude, altitude and land distribution affect patterns of circulation in the atmosphere ● Classify regional climates based on patterns of circulation in the atmosphere Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Climate regions map activity ● Identifying climates activity

Coriolis effect and the outlines of continents. ● Models that can be used to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates can be diagrams, maps and globes, or digital representations.		
Topic B: Climate Change ● Stability in Earth's surface temperature might be disturbed either by sudden events or gradual changes that accumulate over time. ● Human activities and natural processes are examples of factors that have caused the rise in global temperatures over the past century.Human activities play a major role in causing the rise in global temperatures. ● 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 understanding of	Students who understand the concepts are able to: ● Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century ● Reason the effects of greenhouse gases on global temperatures Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Climate Change Newspaper ● Greenhouse gas lab

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. ● Evidence that some factors have caused the rise in global temperature over the last century 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.		
Topic C: Human Impact ● Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. ● All human activities draw on Earth's land, ocean, atmosphere, and biosphere resources and have both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. ● Minerals, fresh water, and biosphere resources are distributed unevenly around the planet as a result of past geologic processes.	Students who understand the concepts are able to: ● Explain how changes in global temperatures impact natural systems on Earth ● Analyze what can be done to mitigate climate change and its effects ● Describe the negative long term impacts of water and air pollution ● Determine why natural resource are important ● Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Human Impact on Climate poster ● Natural Resources Research Project

Sample of Open Education Resources
USGS Educational Resources for Secondary Grades (7–12): This web site contains selected USGS educational resources that may be useful to educators in secondary school grades. Many of these resources can be used directly in the classroom or will be useful in classroom lessons or demonstration activities preparation, or as resources for teacher education and curriculum development. NOAA Education Resources: This website contains access to curriculum resources, professional development opportunities, student opportunities, and outreach events. Next Generation Climate - Grades 6-8 - Lesson 2: Next Generation Climate contains six lessons on climate change for middle school students. In the curriculum, the students investigate causes of global temperature change, research the major repercussions of climate change, and find out how it affects human life. Climate Change and Michigan Forests: The Middle School unit entitled Climate Change and Michigan Forests consists of 10 lessons on climate change and the local environment in Michigan based on forest ecology research conducted at the University of Michigan. **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	**ELL**	**RTI/Students at Risk of Failure**	**Accelerated Students**
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Interdisciplinary Standard(s)	
Mathematics ● **MP.2:** Reason abstractly and quantitatively. (MS-ESS3-2) ● **6.EE.B.6:** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-1),(MS-ESS3-2) ● **7.EE.B.4:** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-1),(MS-ESS3-2)	**English Language Arts** ● **RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1),(MS-ESS3-2) ● **RST.6-8.7:** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2) ● **WHST.6-8.2:** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1) ● **WHST.6-8.9:** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1)

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
SEP 6 - Constructing Explanations and Designing Solutions 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. (MS- ESS3-1) **SEP 7 - Engaging in Argument from Evidence** 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. (MS-ESS3-4)	**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.(MS-ESS3-1) **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. (MS-ESS3-2) **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. (MS-ESS3-4)	**CCC-1: Patterns** Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2) **CCC-2: Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1),(MS-ESS3-4) **CCC-7: Stability and Change** Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5) ***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

	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. (MS-ESS3-5)	consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4) 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. (MS-ESS3-2)

Technology Standard(s)
8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools. **8.1.8.B.1** Synthesize and publish information about a local or global issue or event (ex. telecollaborative project, blog, school web).

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
		CRP1. Act as a responsible and contributing citizen and employee
	A	**CRP2. Apply appropriate academic and technical skills**
	E	**CRP3. Attend to personal health and financial well-being**
	T	**CRP4. Communicate clearly and effectively with reason**
	E	**CRP5. Consider the environmental, social and economic impacts of decisions**
	E	**CRP6. Demonstrate creativity and innovation CRP7.**
		Employ valid and reliable research strategies
	T	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them CRP9.**
		Model integrity, ethical leadership and effective management
	E	**CRP10. Plan education and career paths aligned to personal goals**
	E	**CRP11. Use technology to enhance productivity**
		CRP12. Work productively in teams while using cultural global competence

In this unit plan, the following 21st Century themes and skills are addressed:					
Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E**	**Creativity and Innovation**
		Health Literacy		**E,T, A**	**Collaboration, Teamwork and Leadership**
	X	**Civic Literacy**			**Cross-Cultural and Interpersonal Communication**
	X	**Financial, Economic, Business and**		**E**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 3: Earth's System

Instructional Days: 30

Unit Summary
Students examine geoscience data in order to understand processes and events in Earth's history. Important crosscutting concepts in this unit are scale, proportion, and quantity, stability and change, and patterns in relation to the different ways geologic processes operate over geologic time. An important aspect of the history of Earth is that geologic events and conditions have affected the evolution of life, but different life forms have also played important roles in altering Earth's systems. Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Students are expected to demonstrate proficiency in analyzing and interpreting data and constructing explanations. They are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
MS-ESS2-3	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Unit Sequence and Pacing: Unit 3- Earth's Systems		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Minerals and Rocks in the Geosphere ● Rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. ● The geologic time scale interpreted from rock strata provides a way to organize Earth's history. ● Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. ● The processes of melting, crystallization, weathering, deformation, and sedimentation act together to form minerals and rocks through the cycling of Earth's materials. ● Energy flowing and matter cycling within and among the planet's systems derive from the sun and Earth's hot interior. ● Energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. ● Explanations of stability and	Students who understand the concepts are able to: ● Explain the roles heat and pressure in Earth's interior play in the cycling of matter ● Model the patterns and describe the effects of convection in Earth's mantle ● Describe the characteristics and properties of minerals ● Use models to show the processes that result in the formation of minerals ● Name the three major types of rocks and how they form ● Demonstrate how the formation of rocks is the result of the flow of energy and cycling of matter within Earth Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Rock Cycle Activity ● Mineral Formation Gizmo ● Mighty Mauna Loa Case Study

change in Earth's natural systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.		
Topic B: Tectonic Plates ● Geoscience processes have changed Earth's surface at varying time and spatial scales. ● Processes change Earth's surface at time and spatial scales that can be large or small; many geoscience processes usually behave gradually but are punctuated by catastrophic events. ● Geoscience processes shape local geographic features such as the Pocono Mountains ● Time, space, and energy phenomena within Earth's systems can be observed at various scales using models to study systems that are too large or too small.	Students who understand the concepts are able to: ● Find evidence that supports the hypothesis of Continental Drift ● Explain the roles of mid-ocean ridges and oceanic trenches in the movement of the plates ● Analyze and interpret data to describe evidence that Earth's plates move slow and constant due to forces within the mantle ● Explain the products of plate movements at different scales ● Describe how volcanoes, and earthquakes can result from tectonic plate movement Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Volcano Activity ● Mapping Tectonic Plates ● Earthquake Engineering ● Graham Cracker Tectonic Plates
Topic C: Earth's Systems ● Energy drives the process that results in the cycling of Earth's materials. ● Interactions among Earth's systems have	Students who understand the concepts are able to: ● Describe how weathering and erosion changes Earth's surface ● Evaluate the different ways that Earth's surface can be changed	● Modeling erosion activity ● Ground Shifting Advances Article

shaped Earth's history and will determine its future. ● Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years	Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	

Sample of Open Education Resources
McDougall/Littell: "Our Changing Earth" NOVA: "Our Amazing Planet" History Channel: "The Ring of Fire" Interactive website on the formation and breaking apart of Pangea Gizmos **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Interdisciplinary Standard(s)	
ELA/Literacy	**Mathematics**
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-4),(MS-ESS2-2) **WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS1-4),(MS-ESS2-2)	**7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS2-2),(MS-ESS2-3) **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS2-3) **RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3) **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-1),(MS-ESS2-2)	represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-4),(MS-ESS2-2),(MS-ESS2-3) **7.EE.B.6** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-4) ☐ **MP.2** Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-2: Developing and Using Models ● Develop and use a model to describe phenomena. (MS-ESS2-1) **SEP-4: Analyzing and Interpreting Data** ● Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3) **SEP-6: Constructing Explanations and Designing Solutions** ● 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	**ESS2.A: Earth's Materials and Systems** ● All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1) ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine it's future. (MS-ESS2-2)	**CCC-1: Patterns** ● Patterns in rates of change and other numerical relationships can provide information about natural systems. (CCC-1) **CCC-2: Cause and Effect** ● Explore the relationship between convection in the asthenosphere and tectonic movement and the relationship between tectonic movement and Earth's features and the carbon cycle (CCC-2) **CCC-3: Scale Proportion and Quantity** ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (CCC-3)

describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4),(MS-ESS2-2)	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** ● Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)	**CCC-5: Energy and Matter** ● Energy conservation is maintained as the energy from radioactive isotopes create an atmosphere for convection and tectonic movement (CCC-5) **CCC-7: Stability and Change** ● Earth is constantly changing, however the forces that change it are stable (CCC-7)

Technology Standard(s)
8.1.8.A.3 Use a simulation that provides an environment to solve a real world theory

In this unit plan, the following Career Ready Practices are addressed:		
Indicate whether these skills are E-Encouraged, T-Taught, or A-Assessed in this unit by marking E, T, A on the line before the appropriate skill.		
	E	**CRP1. Act as a responsible and contributing citizen and employee**
	A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E	**CRP4. Communicate clearly and effectively with reason**
	E	**CRP5. Consider the environmental, social and economic impacts of decisions**

	E	**CRP6. Demonstrate creativity and innovation**
	T	**CRP7. Employ valid and reliable research strategies**
		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
	T	**CRP10. Plan education and career paths aligned to personal goals**
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			**21st Century Skills**		
	X	**Global Awareness**		**E,T, A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E,T, A**	**Creativity and Innovation**
		Health Literacy		**E,T, A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,**	**Cross-Cultural and Interpersonal Communication**

				A	
		Financial, Economic, Business and			**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 4: Earth's 4.6 Billion Year History

Instructional Time: 25

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.

Student Learning Objectives	
MS-ES1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
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 Sequence and Pacing: Unit 4- Earth's 4.6 Billion Year History

Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**

Topic A: Geological Time Scale
● The geologic time scale is used to organize Earth's 4.6-billion- year-old history.
● Patterns exist in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in rock layers.
● Patterns can occur within one species of organism or across many species.
● Similarities and differences exist in the gross anatomical structures of modern organisms.
  ● There are anatomical similarities and differences among modern organisms and between modern organisms and fossil organisms.
  ● Similarities and differences exist in the gross anatomical structures of modern organisms and their fossil relatives.
	Students who understand the concepts are able to:
	● Construct an explanation using reasoning to determine the purpose of the geological time scale
	● Analyze evidence the helps define and divide geological time
	● Explain how Earth's history can be organized by major events
	
	Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.
		● Geological Timeline Project
		● History of Earth Gizmo

● Similarities and differences in the gross anatomical structures of modern organisms enable the reconstruction of evolutionary history and the inference of lines of evolutionary decent. ● Patterns and anatomical similarities in the fossil record can be used to identify cause-and-effect relationships. ● Science assumes that objects and events in evolutionary history occur in consistent patterns that are understandable through measurement and observation.		
Topic B: Fossils ● The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. ● The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found or through radioactive dating is known as the fossil record. ● Relative fossil dating is achieved by examining the fossil's relative position in sedimentary rock layers. ● Objects and events in the fossil record occur in consistent patterns that are understandable through measurement and observation.	Students who understand the concepts are able to: ● Identify the current methods geologist use to determine the relative age of rocks ● Give examples of ways geologist provide physical evidence to show that Earth has changed over time due to natural processes Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Development of fossils ● How Fossils Form ● Create a cast, mold, and trace fossil

Research on Student Learning

- Students often hold onto ideas that they have learned from common day language such as “only the strong survive” or “survival of the fittest.” Because of this they may think that evolution is a competition with an immediate result.
- Because of the difficulty we have in conceptualizing that Earth is 4.6 billion years old, it makes it even more difficult to understand that evolution takes an extremely long time to cause an extremely small amount of change.
- Students may feel that primate evolution is a race from “monkey-ness” to “human-ness” with humans being the ultimate end result.

Sample of Open Education Resources

McDougall/Littell: “Our Changing Earth”

History Channel: “Birth of the Earth”

Zumal: web quest

Textbooks used but not limited to:

Pearson Realize Evaluate

Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts

from the community helping with a project, journal articles, and biographies).

- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	**ELL**	**RTI/Students at Risk of Failure**	**Accelerated Students**
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-1),(MS-LS4-2),(MS-LS4-3) ● **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1),(MS-LS4-3) ● **RST.6-8.9** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3) ● **WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2) ● **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2) ● **SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2) ● **SL.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. (MS-LS4-2)	**Mathematics** ● **6.EE.B.6** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-LS4-1),(MS-LS4- 2)

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
SEP-4: Analyzing and Interpreting Data ● Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3) ● Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) **SEP-6: Constructing Explanations and Designing Solutions** ● Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) **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. (MS-LS4-1)	**ESS1.C: The History of Planet Earth** The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4) **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. (MS-LS4-1) ● 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. (MS-LS4-2) ● Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)	**CCC-1: Patterns** ● Patterns can be used to identify cause and effect relationships. (CCC-1) **CCC-2: Cause and Effect** ● Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (CCC-2) **CCC-3: Scale, Proportion and Quantity** ● Understanding the vast scale of 4.6 billion years and the quantity of organisms that have existed vs. those presently existing (CCC- 3)

Technology Standard(s)
8.1.12.A.2 Produce and edit a multi-page digital document for a commercial audience and present it to peers

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
	E,T,A	**CRP1. Act as a responsible and contributing citizen and employee**
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**
	E,T,A	**CRP5. Consider the environmental, social and economic impacts of decisions**
	E,T,A	**CRP6. Demonstrate creativity and innovation**
	E,T,A	**CRP7. Employ valid and reliable research strategies**
	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
	E	**CRP10. Plan education and career paths aligned to personal goals**

	T	**CRP11. Use technology to enhance productivity**
	T	**CRP12. Work productively in teams while using cultural global competence**

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T, A**	**Collaboration, Teamwork and Leadership**
	X	**Civic Literacy**		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E, T**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 5: Astronomy

Instructional Days: 35

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

Student Learning Objectives	
MS-ESS1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.

Unit Sequence and Pacing: Unit 5- Astronomy		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Earth, Sun, Moon Systems ● Patterns in the apparent motion of the sun, moon, and stars in the sky can be observed, described, predicted, and explained with models. ● The Earth and solar system model of the solar system can explain eclipses of the sun and the moon. ● Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the sun. ● The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. ● Patterns can be used to identify cause-and-effect relationships that exist in the apparent motion of the sun, moon, and stars in the sky.	Students who understand the concepts are able to: ● Identify objects and constellations visible without a telescope in the night sky ● Develop models to explain the apparent motions of stars and planets throughout the year. ● Use models to explain the motion of Earth, the planets, and the sun through patterns observed from their models to explain what causes the cycles of seasons on Earth. ● Explain how the moon affects the amount of daylight ● Create models that describe the factors that keep the moon and Earth in its orbit out space. ● Explain why the moon appears to change shape. ● Describe what causes solar and lunar eclipses. ● Create models to predict the position of the Earth, sun and moon during a given type of eclipse. ● Relate how the sun and moon affect tides. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design	● Space Activities for Science Class ● Seasons Stations ● Tides Gizmos ● Exploring Eclipses

	challenges, and laboratory investigations.	
Topic B: Our Solar System ● Science assumes that objects and events in the solar system systems occur in consistent patterns that are understandable through measurement and observation. ● The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids, that are held in orbit around the sun by its gravitational pull on them. ● The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. ● Science assumes that objects and events in the solar systems occur in consistent patterns that are understandable through measurement and observation. ● Objects in the solar system have scale properties. ● Data from Earth-based instruments, space-based telescopes, and spacecraft can be used to determine similarities and differences among solar system objects. ● The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. ●	Students who understand the concepts are able to: ● Analyze data to compare and contrast solar system objects based on their characteristics (size, color, motion, ability to sustain life, geographical feature etc.) ● Develop and use a model to describe the role of gravity on the motions of the planets and other objects in the solar system. ● Explain the role of gravity in the sun's function. ● Compare and contrast the relationships between solar system objects. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Solar System Trading Cards ● Scale of the Solar System Activity

Topic C: The Universe ● Gravity plays a role in the motions within galaxies and the solar system. ● Gravity is the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. ● Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.	Students who understand the concepts are able to: ● Identify the characteristics of the electromagnetic spectrum ● Describe how scientists use the electromagnetic spectrum to learn about the universe. ● Evaluate the role of technology in accessing outer space and collecting, analyzing and communicating data. ● Use evidence to list and describe the physical properties of stars. ● Analyze and interpret data to explain how stars are classified. ● Describe the role gravity plays in the formation of stars. ● Use models to analyze the distances between objects in the universe and the methods used to measure those distances. ● Explain the hierarchical relationship between the various bodies in the universe. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Sizes of Stars ● Study of the Stars Lab Activity

Sample of Open Education Resources

NASA Solar System Exploration

Seasons Interactive provides students with the opportunity to investigate how Earth's angle of inclination affects three factors: the angle of incoming sunlight, average daily temperatures and the Sun's ecliptic path. Students will be able to construct an explanation for the occurrence of seasons.

Eclipse Interactive, students investigate both lunar and solar eclipses by manipulating up to three independent variables: Moon's tilt from orbit, Earth-Moon distance and size of the Moon. By viewing the effects of changes to these variables, students will be able to construct explanations for solar and lunar eclipses. The model includes both top and side views of the Earth-Moon system during the Moon's revolution. In addition, students can toggle to show outlines of the Earth and Moon. Teachers should note that the simulation has been designed as a single screen model that automatically moves between solar and lunar eclipses without any indication of time. As a result, younger students may become confused and will need to be reminded about the duration of lunar months.

The Pull of the Planets is part of a thematic series of lessons highlighting the Juno mission to Jupiter. It is a traditional hands-on activity that models how gravitational forces can keep planets and asteroids in orbit within the Solar System. Using a stretchable fabric held in place with an embroidery hoop, students work with spheres of various materials to explore how mass and sizes affect the strength of gravitational forces. Background materials, including a materials sheet, aid teachers in organizing this activity.

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.

- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Positionstudentnearhelpingpeer or have quick access to teacher ● Anticipate where needs will be and break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOEresources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOEresources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Interdisciplinary Standard(s)

ELA/Literacy	Mathematics
● **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3) ● ● **RST.6-8.7** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3) ● ● **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS1-1)	● **6.EE.B.6** - Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-2) ● ● **6.RP.A.1** - Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1), (MS-ESS1-2), (MS-ESS1-3) ● ● **7.EE.B.4** - Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS1-2) ● ● **7.RP.A.2** - Recognize and represent proportional relationships between quantities. (MS-ESS1-1), (MS-ESS1-2), (MS-ESS1-3) ● ● **MP.2** - Reason abstractly and quantitatively. (MS-ESS1-3) ● **MP.4** - Model with mathematics. (MS-ESS1-1), (MS-ESS1-2)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-2: Developing and Using Models ● Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) SEP-4: Analyzing and Interpreting Data ● Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.(MS-ESS1-3)	ESS1.A: The Universe and Its Stars ● Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) ● Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) ESS1.B: Earth and the Solar System ● The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.(MS-ESS1-2), (MS-ESS1-3) ● This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1) ● The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.(MS-ESS1-2)	CCC-1: Patterns ● Patterns can be used to identify cause-and-effect relationships.(MS-ESS1-1) CCC-3: Scale, Proportion, and Quantity ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3) CCC-4: Systems and System Models ● Models can be used to represent systems and their interactions. (MS-ESS1-2) Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology ● Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems.(MS-ESS1-3) Connections to Nature of Science Scientific Knowledge Assumes an Order and Consistency in Natural Systems ● Science assumes that objects and events in natural systems occur in

		consistent patterns that are understandable through measurement and observation. (MS-ESS1-1), (MS-ESS1-2)

Technology Standard(s)
8.2.8.A.1 Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.telephone for communication - smart phone for mobility needs). **8.2.8.A.2** Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system. **8.2.8.A.3** Investigate a malfunction in any part of a system and identify its impacts. The relationships among technologies and the connections between technology and other fields of study. **8.2.8.A.4** Redesign an existing product that impacts the environment to lessen its impact(s) on the environment.

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	A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E	**CRP4. Communicate clearly and effectively with reason**
	E	**CRP5. Consider the environmental, social and economic impacts of decisions**
	E	**CRP6. Demonstrate creativity and innovation**

	T	**CRP7. Employ valid and reliable research strategies**
		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
	E	**CRP10. Plan education and career paths aligned to personal goals**
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Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E,T, A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E**	**Creativity and Innovation**
		Health Literacy		**E,T**	**Collaboration, Teamwork and Leadership**
		Civic Literacy			**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Earth and Space Sciences				
MS-ESS1 Earth's Place in the Universe				
MS-ESS1-1	**Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.**	**X**		
MS-ESS1-2	**Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.**	**X**		
MS-ESS1-3	**Analyze and interpret data to determine scale properties of objects in the solar system.**	**X**		
MS-ESS1-4	**Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.**	**X**		
MS-ESS2 Earth's Systems				
MS-ESS2-1	**Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.**	**X**		
MS-ESS2-2	**Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.**	**X**		
MS-ESS2-3	**Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.**	**X**		
MS-ESS2-4	**Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.**	**X**		
MS-ESS2-5	**Collect data to provide evidence for how the motions and complex interactions of air**	**X**		

	masses results in changes in weather conditions.			
MS-ESS2-6	**Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.**	**X**		
MS-ESS3 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.**	**X**		
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.**	**X**		
MS-ESS3-3	**Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.**	**X**		
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.**	**X**		
MS-ESS3-5	**Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.**	**X**		

STANDARD	**PERFORMANCE EXPECTATION**	**6TH GRADE**	**7TH GRADE**	**8TH GRADE**
Life Science				
MS-LS1 From Molecules to Organisms: Structures and Processes				
MS-LS1-1	**Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.**			**X**
MS-LS1-2	**Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.**			**X**

MS-LS1-3	**Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.**			**X**
MS-LS1-4	**Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.**			**X**
MS-LS1-5	**Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.**			**X**
MS-LS1-6	**Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.**			**X**
MS-LS1-7	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as the matter moves through organism.**			**X**
MS-LS1-8	**Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.**			**X**
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics				
MS-LS2-1	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.**			**X**
MS-LS2-2	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**			**X**
MS-LS2-3	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.**			**X**
MS-LS2-4	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.**			**X**
MS-LS2-5	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services.**			**X**
MS-LS3 Heredity: Inheritance and Variation of Traits				

MS-LS3-1	**Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.**			**X**
MS-LS3-2	**Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.**			**X**

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

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Physical Science				
MS-PS1 Matter and Its Interactions				
MS-PS1-1	Develop models to describe atomic composition of simple molecules and extended structures.		x	
MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.		x	
MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.		x	
MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.		x	
MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.		x	
MS-PS1-6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.		x	
MS-PS2 Motion and Stability: Forces and Interactions				
MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.		X	
MS-PS2-2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.		X	
MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.		X	
MS-PS2-4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.		X	X

MS-PS2-5	**Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**		**X**	
MS-PS3 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.**		**X**	
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.**		**X**	
MS-PS3-3	**Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer**		**X**	
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.**		**X**	
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.**		**X**	

STANDARD	**PERFORMANCE EXPECTATION**	6^{TH} GRADE	7^{TH} GRADE	8^{TH} GRADE
Physical Science				
MS-PS4 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.**		**X**	
MS-PS4-2	**Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.**		**X**	
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.**		**X**	

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Engineering Design				
MS – ETS1 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.**	**X**	**X**	**X**
MS-ETS1-2	**Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**		**X**	**X**
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.**	**X**	**X**	**X**
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.**		**X**	

Middle Township

Middle School

7th Grade

Science

Curriculum

Table of Contents

ACKNOWLEDGMENTS

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PHILOSOPHY AND GOALS

This document serves to meet all requirements for curriculum as per the Middle Township Board of Education and the New Jersey Department of Education and will serve as a guide for lesson planning. Units within the curricular framework for science are designed to be taught in the order in which they are presented. Within the units, the teachers have flexibility of what order to present the standards. Suggested Science and Engineering Practice Standards and Cross-Cutting Concepts are listed in each unit to be embedded regularly in daily science instruction.

Middle School science in Middle Township Public School district is interdisciplinary and covers all four domains of the Next Generation Science Standards: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science. The goal of science education curriculum is to produce students who have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives. They should come to appreciate that science and the current scientific understanding of the world are the result of many hundreds of years of creative human endeavor. It is especially important to note that the above goals are for all students, not just those who pursue careers in science, engineering, or technology or those who continue on to higher education (p. 9, NRC, 2012).

Given this goal, an integrated science curriculum model should drive the formation of middle school science curriculum because:

- The nature of science is complex and multidisciplinary.
- Learning theory research in science shows expert knowledge base develops better through interdisciplinary connections and not through isolated content.
- Effective research-based practices for curriculum and instruction in science and engineering are supported through this approach.

The nature of science is complex and multidisciplinary. From research about how scientists work, we know that scientists do not work in isolation in their own house of physics, or biology or chemistry but they reach out and create networks of scientists within and across disciplines who can contribute understanding, share ideas, and critique evidence and explanations. As we see in the science of global climate change, scientists work across the fields of geology, physics, and biology to provide evidence, plan investigations, and develop models to represent new ways to think about Earth systems. Important practices like engaging in argument from evidence, modeling, and communicating information do not occur in isolation but rely on feedback from within and across scientific communities and disciplines. Basing the middle school model curriculum in an integrated model where the students are engaged with a variety of topics at each grade, focused on the connection of ideas across the domains, enhances the interdisciplinary nature of science.

In the elementary years, students build their understanding of core concepts across all three domains of science: physical, life and Earth and space. Continuing this model in grades 6-8 better supports student learning in that there will not be a large gap of time in which a student does not engage in a specific discipline. This model takes advantage of current research which recognizes that there is variation across children at a given age and that thinking does not develop along a preset roadmap for each student. It allows middle school students to build on what they know and think they understand from their elementary years with the goal in middle school of helping students to revise their knowledge and understanding about those core ideas. Learning theory research shows expert knowledge base develops better through interdisciplinary real-world connections than through isolated content. This is especially important in middle school where motivation is critical to learning. An integrated and better articulated middle school model science curriculum that reflects what we know currently about how children learn science and how their mastery develops over time promotes deeper learning in science. As we know and understand about how students develop understanding while learning content, it informs teachers' practice; if teachers understand where their students are in their understanding of core ideas, and anticipate what students' misconceptions and struggles may be, they are better able to differentiate instruction and provide scaffolding that allows students to develop an integrated and deeper understanding of the science.

DIVERSITY AND INCLUSION

In alignment with the New Jersey Student Learning Standards, the Science curriculum materials will:

- Cultivate respect towards minority groups to foster appreciation of their differences as well as recognizing their contributions to the advancement of science and technology.

- Evaluate experiences of people of diverse backgrounds and their unique journeys, including challenges and successes, and their significant historic contributions to the scientific, economic, political, and social development of New Jersey and the United States.

- Analyze grade-level texts highlighting the technological and scientific contributions of persons of different genders, ethnicities, and abilities.

- Apply the critical thinking process to develop empathy, challenging biases, to better understand different perspectives and experiences to creatively problem-solve and innovate solutions for diverse groups of people with specific needs.

● Engage in authentic learning experiences that enable students to acquire and incorporate varied perspectives, and to communicate with diverse audiences while applying content knowledge, integrating concepts across disciplines, and developing scientific thinking skills.

● Participate in an inclusive and diverse scientific culture that appreciates and incorporates perspectives from people of different genders, ethnicities, and abilities.

● Understand how scientific, economic, political, social, and cultural aspects of society drive development of new scientific and technological products, processes, and systems.

● Reflect on personal experiences and the experiences of others building empathy and promoting a climate of respect and acceptance of people with different backgrounds and abilities.

Three Dimensions of the Next Generation Science Standards

The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence- based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires.

Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and function; Stability and change. The Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.

Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
- Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
- Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;

- Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

7th Grade Physical Science and Pacing Guide			
Unit of Study	**Concepts**	**NGSS**	**Instructional Days**
Unit 1- Properties and Interactions of Matter	A: Matter B: Atoms and Bonds	MS-PS1-1 MS-PS1-4	25
Unit 2- Chemical Reactions	A: Chemical Changes B: Conservation of Matter during Chemical Reactions	MS-PS1-2 MS-PS1-3 MS-PS1-5	20

	C: Energy During a Chemical Reaction	MS-PS1-6	
Unit 3- Forces and Motion	A: Motion and Forces B: Newton's 2 Laws of Motion	MS-PS2-1 MS-PS2-2 MS-ETS1-2	30
Unit 4- Interactions Between Forms of Energy	A: Types of Energy B: Transfer and Transformation of Energy	MS-PS3-1 MS-PS3-2 MS-PS3-5 MS-ETS1-4	35
Unit 5- Thermal Energy	A: Temperature and Thermal Energy B: Heat Transfer	MS-PS3-3 MS-PS3-4 MS-ETS1-3	15
Unit 6- Waves and the Electromagnetic Spectrum	A: Wave Properties B: Light and Sound C: Electromagnetic Spectrum	MS-PS4-1 MS-PS4-2 MS-PS4-3	20
Unit 7- Forces that Act at a Distance	A: Gravity B: Electricity and Magnetism	MS-PS2-3 MS-PS2-4 MS-PS2-5	20

Unit 1: Properties and Interactions of Matter

Instructional Days:25

Unit Summary
Students build understandings of what occurs at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They also provide molecular level accounts to explain states of matter and changes between states. The crosscutting concepts of cause and effect, scale, proportion and quantity, structure and function, interdependence of science, engineering, and technology, and the influence of science, engineering and technology on society and the natural world provide a framework for understanding the disciplinary core ideas. Students demonstrate grade appropriate proficiency in developing and using models, and obtaining, evaluating, and communicating information. Students are also expected to use the scientific and engineering practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures.
MS-PS1-4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Unit Sequence and Pacing:		
Concepts	Assessments (Formative and Summative)	Related Activities, Readings, and Resources
Topic A: Matter ● Substances are made from different types of atoms. ● Density, melting point, boiling point, solubility, flammability, and odor are characteristic properties that can be used to ● Macroscopic patterns are related to the nature of the atomic-level structure of a substance ● Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	Students who understand these concepts are able to: ● Identify and explain the motion of the particles in each state of matter ● Describe how moton energy is transferred to an from an object ● Model how different elements have a different number of protons neutrons and electrons Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Density Dinos ● Penny Boats ● A Matter of Fact ● Balloon Graph
Topic B: Atoms and Bonds ● Atoms are the basic units of matter. ● Substances combine with one another in various ways. ● Molecules are two or more atoms joined together. ● Atoms form molecules that range in size from two to thousands of atoms. ● Molecules can be simple or very complex. ● Substances react chemically in characteristic	Students who understand these concepts are able to: ● Identify and describe the properties of electrons, protons and neutrons ● List the parts of an atoms and describe atomic theory ● Find evidence that supports the modern model of the atom ● Interpret and use the periodic table for locating important information pertaining to the elements and describe the elements	● Adopt and Element Project ● Atoms, Ions and Isotopes Practice ● Model of an Atom ● Iron Extraction Lab

ways. ● In a chemical process, the atoms that make up the original substances are regrouped into different molecules; these new substances have different properties from those of the reactants. ● The analysis of data on the properties of products and reactants can be used to determine whether a chemical process has occurred.	● Explain the role of valence electrons in bonding of atoms ● Describe how the properties of atoms are affected when atoms bond together ● Compare the properties of metals and nonmetals ● Identify the types of bonds that form between atoms ● Analyze how bonds determine certain properties of compounds ● Interpret data to explain what happens when acids and bases interact Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	

Sample of Open Education Resources
Middle school Chemistry, Chapter 1: Solids, Liquids, and Gases Students are introduced to the idea that matter is composed of atoms and molecules that are attracted to each other and in constant motion. Students explore the attractions and motion of atoms and molecules as they experiment with and observe the heating and cooling of a solid, liquid, and gas. Middle school Chemistry, Chapter 2: Changes of State Students help design experiments to test whether the temperature of water affects the rate of evaporation and whether the temperature of water vapor affects the rate of condensation. Students also look in more detail at the water molecule to help explain the state changes of water. (all activities/lessons) States of Matter: Use interactive computer models to trace an atom's trajectory at a certain physical stage, and investigate how molecular behavior is responsible for the substance's state. Molecular View of a Solid: Explore the structure of a solid at the molecular level. Molecules are always in motion, though molecules in a solid move slowly. All molecules are attracted to each other. Molecules can be weakly or strongly attracted to each other. The way that large molecules interact in physical,

chemical and biological applications is a direct consequence of the many tiny attractions of the smaller parts.

Molecular View of a Liquid: Explore the structure of a liquid at the molecular level. Molecules are always in motion. Molecules in a liquid move moderately. All molecules are attracted to each other. Molecules can be weakly or strongly attracted to each other. The way that large molecules interact in physical, chemical and biological applications is a direct consequence of the many tiny attractions of the smaller parts.

Textbooks used but not limited to:

Pearson Realize Elevate

Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-PS1-3) ● **RST.6-8.7** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1), (MS-PS1-4) ● **WHST.6-8.8** - Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)	**Mathematics** ● **6.NS.C.5** - Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4) ● **6.RP.A.3** - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-PS1-1) ● **8.EE.A.3** - Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1) ● **MP.2** - Reason abstractly and quantitatively. (MS-PS1-1) ● **MP.4** - Model with mathematics. (MS-PS1-1)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-2: Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop a model to predict and/or	**PS1.A: Structure and Properties of Matter** ● Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) ● Each pure substance has	**CCC-2: Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

describe phenomena. (MS-PS1-1), (MS-PS1-4)

SEP-8: 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. (MS-PS1-3)

characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)*

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.(MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS- PS1-4)

PS1.B: Chemical Reactions

Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) *(Note: This Disciplinary CoreIdea is also addressed by*

CCC-3: Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS- PS1-1)

CCC-6: 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. (MS-PS1-3)

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. (MS-PS1-3)

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every

	MS-PS1-2.) **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)* • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)*	field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3)

Technology Standard(s)	
Core Ideas	**Performance Expectations**

In this unit plan, the following Career Ready Practices are addressed:	
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	
E	**CRP1. Act as a responsible and contributing citizen and employee**
A	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**
E	**CRP5. Consider the environmental, social and economic impacts of decisions**
E	**CRP6. Demonstrate creativity and innovation**
T	**CRP7. Employ valid and reliable research strategies**
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
T	**CRP10. Plan education and career paths aligned to personal goals**
	CRP11. Use technology to enhance productivity

		CRP12. Work productively in teams while using cultural global competence

21st Century Skills					
	X	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E**	**Creativity and Innovation**
		Health Literacy		**E,T**	**Collaboration, Teamwork and Leadership**
		Civic Literacy			**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 2: Chemical Reactions

Instructional Days:20

Unit Summary
Students provide molecular-level accounts of states of matters and changes between states, of how chemical reactions involve regrouping of atoms to form new substances, and of how atoms rearrange during chemical reactions. Students also apply their understanding of optimization design and process in engineering to chemical reaction systems. The crosscutting concept of energy and matter provides a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students are also expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Student Learning Objectives	
MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-PS1-6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

Unit Sequence and Pacing:		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Chemical Changes ● Substances react chemically in characteristic ways. ● In a chemical process, the atoms that make up the original substances are regrouped into different molecules. ● characteristics of the design that performed the best in each test can provide useful information for the redesign process. * Some of the characteristics identified as having the best performance may be incorporated into the new design.	Students who understand these concepts are able to: ● Analyze and interpret data about the properties of a substance to determine if a change in matter is physical or chemical ● Identify and describe the factors that affect the rate at which a chemical reaction occurs Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Use physical models or drawings, including digital forms, to represent atoms in a chemical process. ● How Cookies are made
Topic B: Conservation of Matter during Chemical Reactions ● New substances created in a chemical process have different properties from those of the reactants. ● The total number of each type of atom in a chemical process is conserved, and thus the mass does not change (the law of conservation of matter).	Students who understand these concepts are able to: ● Interpret and develop models to identify components of a chemical reaction ● Use chemical equations to model mass conservation during a chemical change ●	● Use mathematical descriptions to show that the number of atoms before and after a chemical process is the same. ● Balancing Chemical Reactions ● Chemical Reactions Stations

● Matter is conserved because atoms are conserved in physical and chemical processes. ● The law of conservation of mass is a mathematical description of natural phenomena.	Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic C: Energy During Chemical Reactions ● Some chemical reactions release energy, while others store energy. ● The transfer of thermal energy can be tracked as energy flows through a designed or natural system. ● Models of all kinds are important for testing solutions. ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. ● 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. ● A solution needs to be tested and then modified on the basis of the test results in order for it to be improved.	Students who understand these concepts are able to: ● Compare and contrast endothermic and exothermic reactions ● -Explain how synthetic materials are made from natural resources Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Elephant Toothpaste Lab ● Making Ice Cream ● Synthetic Materials Production Activity

Sample of Open Education Resources

Salt or Sugar: Which Dissolves Faster in Different Liquids? Chemical Reactions

- Can You Copperplate? This lesson plan introduces students to the process of plating one metallic object with another metal and the importance of this process in engineering applications. With parameters, students design strategies to copperplate other metal objects using…
- Balancing Chemical Equations In this interactive simulation, users adjust the coefficients in an equation while the molecules are depicted in a box above the equation. This allows the users to visualize what the symbols in the chemical equation actually mean. They can count t…
- Energy Changes in Chemical Reactions This is a 5E laboratory lesson plan about endothermic and exothermic reactions. Teaching resources include activity sheets for assessment, answer sheets, a variety of video clips and animations to support the students' learning of the concepts, backg…
- Baggie Chemistry Students begin the activity by brainstorming observable changes that indicate a chemical change has occurred. They then mix calcium chloride with water and measure the temperature change during the reaction. Next, they add baking soda to the solut…
- Design and Build a Biosuit The overarching unit has students learn about, design, and build biosuits - suits designed to protect people in potentially dangerous conditions while allowing for complex tasks to still be completed.

Textbooks used but not limited to:

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Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
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Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time/prioritize tasks ● Use concrete terms/provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-PS1-2) ● **RST.6-8.3** - Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS- PS1-6) ● **RST.6-8.7** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-2), (MS-PS1-5) ● **WHST.6-8.7** - Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)	**Mathematics** ● **6.RP.A.3** - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-PS1-2), (MS-PS1-5) ● **6.SP.B.4** - Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2) ● **6.SP.B.5** - Summarize numerical data sets in relation to their context. (MS-PS1-2) ● **MP.2** - Reason abstractly and quantitatively. (MS-PS1-2), (MS-PS1-5) ● **MP.4** - Model with mathematics. (MS-PS1-5)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-2: Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop a model to describe unobservable mechanisms. (MS-PS1-5) **SEP-: Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between	**PS1.A: Structure and Properties of Matter** ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* **PS1.B: Chemical Reactions** ● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the	**CCC-1: Patterns** ● Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) **CCC-5: Energy and Matter** ● Matter is conserved because atoms are conserved in physical and chemical processes.(MS-PS1-5) ● The transfer of energy can be tracked as energy flows through a designed or

correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) **SEP-6: 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. ● Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) **Connections to Nature of Science** **Science Knowledge Is Based on Empirical Evidence** ● Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)	original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2), (MS-PS1-5) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* ● The total number of each type of atom is conserved, and thus the mass does not change.(MS-PS1-5) ● Some chemical reactions release energy, others store energy. (MS-PS1-6) **ETS1.B: Developing Possible Solutions** ● A solution needs to be tested, and then modified on the basis of the test results in order to improve it. *(secondary to MS-PS1-6)* **ETS1.C: Optimizing the Design Solution** ● Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)* ● The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(secondary to MS-PS1-6)*	natural system. (MS-PS1-6)

Technology Standard(s)
8.1.8.B.1 Synthesize and publish information about a local or global issue or event (ex. telecollaborative project, blog, school web). **8.1.8.A.2** Create a document (e.g. newsletter, reports, personalized learning plan, business letters or flyers) using one or more digital applications to be critiqued by professionals for usability. **8.2.8.D.3** Build a prototype that meets a STEM-based design challenge using science

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
		CRP1. Act as a responsible and contributing citizen and employee
	T	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E	**CRP4. Communicate clearly and effectively with reason**
		CRP5. Consider the environmental, social and economic impacts of decisions
	E	**CRP6. Demonstrate creativity and innovation**
		CRP7. Employ valid and reliable research strategies
	T	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management

	A	**CRP10. Plan education and career paths aligned to personal goals**
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E,T**	**Critical Thinking & Problem Solving**
		Environmental Literacy		**E**	**Creativity and Innovation**
	X	**Health Literacy**		**E,T, A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy			**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 3: Forces and Motion

Instructional Days: 30

Unit Summary
Students use system and system models and stability and change to understand ideas related to why some objects will keep moving and why objects fall to the ground. Students apply Newton's third law of motion to related forces to explain the motion of objects. Students also apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of system and system models and stability and change provide a framework for understanding the disciplinary core ideas. Students demonstrate proficiency in asking questions, planning and carrying out investigations, designing solutions, engaging in argument from evidence, developing and using models, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
MS-PS2-2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Unit Sequence and Pacing:		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Motion and Forces ● Animate and inanimate objects exert forces on objects at all times.	Students who understand these concepts are able to: ● Explain how speed motion and position are related. ● Solve for speed Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Motion of a tennis ball activity ● Solve for speed and acceleration ● Solve for the speed of a marble using distance/time
Topic B:Newton's 3 Laws ● Forces cannot always be seen and that inertia is directly related to mass, not weight or speed. ● The interaction of forces causes an object to either remain at a constant velocity or accelerate. ● Friction may only come into play when objects are in motion.	Students who understand these concepts are able to: ● Explain how a force affects an object's motion and how the motion is affected by air resistance and mass. ● Demonstrate how the inertia of an object affects its motion. ● Show what happens to objects that have balanced and unbalanced forces acting on them. ● Use Newton's Second Law to infer how much force is being applied to an object that is traveling at a constant velocity. ● Evaluate the following statement: Jim will	● Mini project cartoon strip on Newton's laws Both graded with a rubric ● Balloon Races ● Marble Races ● Newton Car Activity

	not help push a heavy box. He says, “My force will produce an opposite force and cancel my effort.” • Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students’ published work, unit tests and section quizzes, design challenges, and laboratory investigations.	

Research on Student Learning
Students tend to think of force as a property of an object ("an object has force," or "force is within an object") rather than as a relation between objects. In addition, students tend to distinguish between active objects and objects that support or block or otherwise act passively. Students tend to call the active actions "force" but do not consider passive actions as "forces". Teaching students to integrate the concept of passive support into the broader concept of force is a challenging task even at the high-school level. Students believe constant speed needs some cause to sustain it. In addition, students believe that the amount of motion is proportional to the amount of force; that if a body is not moving, there is no force acting on it; and that if a body is moving there is a force acting on it in the direction of the motion. Students also believe that objects resist acceleration from the state of rest because of friction -- that is, they confound inertia with friction. Students also have a difficult time understanding that inertia is related to mass and does not change unless mass changes (assume that inertia increases as speed increases). Students tend to hold on to these ideas even after instruction in high-school or college physics. Specially designed instruction does help high-school students change their ideas. Research has shown less success in changing middle-school students' ideas about force and motion. Nevertheless, some research indicates that middle-school students can start understanding the effect of constant forces to speed up, slow down, or change the direction of motion of an object. This research also suggests it is possible to change middle-school students' belief that a force always acts in the direction of motion. Students have difficulty appreciating that all interactions involve equal forces acting in opposite directions on the separate, interacting bodies. Instead they believe that "active" objects (like hands) can exert forces whereas "passive" objects (like tables) cannot. Alternatively, students may believe that the object with more of some obvious property will exert a greater force (NSDL, 2015).

Sample of Open Education Resources
McDougall/Littell “Forces and Motion” YouTube videos of astronauts in the ISS YouTube videos of “The Physics of Skydiving” Hawking video “Time Travel” which also explains relative motion **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation
● Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community. ● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). ● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue.

- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Positionstudentnearhelpingpeer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOEresources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOEresources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Interdisciplinary Standard(s)	
ELA/Literacy ● Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS2-1),(MS-ETS1-1),(MS-ETS1-2) RST.6-8.1 ● Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS- PS2-1),(MS-PS2-2) RST.6-8.3 ● Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) WHST.6-8.8 ● Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) WHST.6-8.9 ● Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) RST.6-8.9 ● Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2) WHST.6-8.7	**Mathematics** ● Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3),(MS-ETS1-1),(MS-ETS1-2) MP.2 ● Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1) 6.NS.C.5 ● Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1),(MS-PS2-2) 6.EE.A.2 ● Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-PS2-1),(MS-PS2-2) 7.EE.B.3 ● Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-PS2-1),(MS-PS2-2) 7.EE.B.4 ● Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. ● Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2) 7.EE.3

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
SEP-1: Asking Questions and Defining Problems ● 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. (SEP-1) **SEP-2: Developing and Using Models** ● Develop a model that predicts or describes phenomena such as balls rolling, bouncing, coming to a stop, or falling. Use this information to predict what happens to a skydiver or an object in the international space station. (SEP-2) **SEP-3: Planning and Carrying Out Investigations** ● 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. (SEP-3) **SEP-4: Analyze and Interpret Data** ● In combination with Unit 7.2, analyze data	**PS2.A: Forces and Motion** ● For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1) ● The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) ● All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2) 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. (MS-ETS1-1) ETS1.B:	**CCC-2: Cause and Effect** ● May be used to predict phenomena is nature or designed systems (CCC-2) **CCC-3: Scale, Proportion, and Quantity** ● The distance at which forces such as gravity occur has a proportional affect motion. The sum of forces affect the motion of an object (CCC-3) **CCC-4: 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. (CCC-4) **CCC-5: Energy and Matter** ● Both matter and energy are conserved. Transfer of energy can be tracked through systems (CCC-5) **CCC-7: Stability and Change** ● Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time

pertaining to the motion of a marble (roller coaster car) on a foam tubing track. (SEP-4) **SEP-6: Constructing Explanations and Designing Solutions** ● Apply scientific ideas or principles to design an object, tool, process or system. (SEP-6) **SEP-7: Engage in Argument from Evidence** ● Argue the results of a ball lab, skydiver videos, and space station videos (SEP-7)	Developing Possible Solutions ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2) ● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) ● Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1- 3) ● Models of all kinds are important for testing solutions. (MS-ETS1-4) ETS1.C: **Optimizing the Design Solution** ● Although one design may not perform the best across all tests, identifying the characteristics of a larger change in motion. (MS- PS2-2) ● All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2) 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	and forces at different scales. (CCC-7)

	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. (MS-ETS1-1) 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. (MS-ETS1-2) ● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) ● Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1- 3) ● Models of all kinds are important for testing solutions. (MS-ETS1-4) ETS1.C: Optimizing the Design Solution	

Technology Standard(s)
8.1.8.A.2 Create a document using one or more digital applications **8.1.8.A.3** Use a simulation that provides an environment to solve a real world problem **8.1.8.A.4** Graph and calculate data and present a summary of the results

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
	E	**CRP1. Act as a responsible and contributing citizen and employee**
	E, T	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E, T	**CRP4. Communicate clearly and effectively with reason**
		CRP5. Consider the environmental, social and economic impacts of decisions
	E, T, A	**CRP6. Demonstrate creativity and innovation**
	E, T, A	**CRP7. Employ valid and reliable research strategies**
	E, T	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	E, T, A	**CRP9. Model integrity, ethical leadership and effective management**
	E, T	**CRP10. Plan education and career paths aligned to personal goals**
	E	**CRP11. Use technology to enhance productivity**
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	x	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
		Environmental Literacy		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E,T**	**Communication and Media Fluency**
	X	**Entrepreneurial Literacy**		**E,T,A**	**Accountability, Productivity and Ethics**

Unit 4: Interactions Between Forms of Energy

Instructional Days: 35

Unit Summary
In this unit, students use the practices of analyzing and interpreting data, developing and using models, and engaging in arguments from evidence to make sense of the 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.

Student Learning Objectives	
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
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Unit Sequence and Pacing:		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A:Types of Energy Kinetic energy is related to the mass of an object and to the speed of an object. ● Potential energy is the energy an object has due to its position above the ground. ● Kinetic energy has a relationship to mass separate from its relationship to speed. ● Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed.	Students who understand these concepts are able to: ● Explain how work and force are related ● Identify the two types of mechanical energy and explain each type ● 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 ● Design an experiment that shows how a change in mass and velocity affect the kinetic energy Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Solve for work using W=Fxd ● Build and explore pendulums ● Kinetic Energy Cars
Topic B:Energy Transfer and Transformation ● Proportional relationships among different types of quantities provide information about the magnitude of properties and processes. ● The Law of Conservation of Energy states, Energy can not be created nor destroyed only transferred or transformed; therefore the total	Students who understand these concepts are able to: ● 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 ● Create a web that shows how energy is stored in a system ● Use the Law of Conservation of Energy to	● Roller Coaster Project ● Energy Chain Poster ● Build an online skate park using PHET website

energy of a system remains constant.	explain “energy loss” in a system Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students’ published work, unit tests and section quizzes, design challenges, and laboratory investigations.	

Research on Student Learning

- Students tend to think that energy transformations involve only one form of energy at a time. Although they develop some skill in identifying different forms of energy, in most cases their descriptions of energy-change focus only on forms which have perceivable effects. Finally, it may not be clear to students that some forms of energy, such as light, sound, and chemical energy, can be used to make things happen.
- The idea of energy conservation seems counterintuitive to middle- school students who hold on to the everyday use of the term energy. Even after instruction, however, students do not seem to appreciate that energy conservation is a useful way to explain phenomena. A key difficulty students have in understanding conservation appears to derive from not considering the appropriate system and environment. In addition, middle students tend to use their conceptualizations of energy to interpret energy conservation ideas. For example, some students interpret the idea that "energy is not created or destroyed" to mean that energy is stored up in the system and can even be released again in its original form. Or, students may believe that no energy remains at the end of a process, but may say that "energy is not lost" because an effect was caused during the process (for example, a weight was lifted) (NSDL, 2015)
- A deeper understanding of conservation of energy comes during the next unit “thermal energy” since they can then understand that kinetic energy can be at the atomic level. When a ball bounces off the floor the floor gains thermal energy, the air around the ball gains thermal energy, the sound is a form of kinetic energy that moves particles.

Sample of Open Education Resources
Pearson Realize Elevate PHET skatepark PHET pendulum Youtube video “X Games Big Vert Skateboard Competition” **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation
● Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community. ● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). ● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue. ● Provide ELL students with multiple literacy strategies. ● Collaborate with after-school programs or clubs to extend learning opportunities.

- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6.8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. *(MS-PS3-1),(MS-PS3-5)* ● **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS3-1) ● **WHST.6-8.1** Write arguments focused on discipline content. *(MS-PS3-5)* ● **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS3-2)*	**Mathematics** ● **MP.2** Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5) ● **6.RP.A.1** Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),*(MS-PS3-5)* ● **6.RP.A.2** Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. *(MS-PS3-1)*Recognize and represent proportional relationships between quantities. (MS-PS3-1),*(MS-PS3-5)* ● **8.EE.A.1** Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1) ● **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 √2 is irrational. *(MS- PS3-1)*

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-1: Ask Questions and Define Problem ● Determine how best to build a roller coaster using foam tubing and a marble (SEP-1)	**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. (MS-PS3-1) ● A system of objects may also contain	**CCC-1: Patterns** ● Graphs and tables can be used to identify patterns in data (CCC-1) **CCC-3: Scale, Proportion, and Quantity** ● Energy levels may depend on height, mass, speed, and gravitational

SEP-2: Developing and Using Models

- Develop a model to describe unobservable mechanisms. (SEP-2)

SEP-3: Planning and Carrying Out Investigation

- Coaster build (SEP-3)

SEP-4: Analyzing and Interpreting Data

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (SEP-4)

SEP-5: Using Mathematics and Computational Thinking

- Construct a data table for kinetic and potential energy levels assuming no friction is present (SEP-5)

SEP-6: Construct Explanations and Design Solutions

- Explain scientific processes taking place from this unit and 7.1 (SEP-6)

SEP-7: Engaging in Argument from Evidence

- 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. (SEP-7)

SEP-8: Obtaining, Evaluating, and

stored (potential) energy, depending on their relative positions. (MS-PS3-2)

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. (MS-PS3-5)

PS3.C: Relationship Between Energy and Forces

- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS- PS3-2)

acceleration (CCC-3)

CCC-4: Systems and System Models

- A model, such as a roller coaster, can be used to represent interactions of forces and energy levels/types (CCC-4)

CCC-5: Energy and Matter

- Energy may take different forms and can be tracked through systems (CCC-5)

CCC-6: Structure and Function

- The shape and properties of materials can be manipulated for various results (CCC-6)

Communicating Information ● Prepare a formal lab report on their project (SEP-8)		

Technology Standard(s)
8.1.8.A.3 Use a simulation to provide an environment to solve a real world problem 8.1.8.A.4 Graph and calculate data and present a summary

In this unit plan, the following Career Ready Practices are addressed:	
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	
E,T A	**CRP1. Act as a responsible and contributing citizen and employee**
E,T,A	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E,T,A	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
E,T,A	**CRP6. Demonstrate creativity and innovation**
E,T,A	**CRP7. Employ valid and reliable research strategies**
E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**

		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
	E,T,A	**CRP11. Use technology to enhance productivity**
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E,T,A**	**Communication and Media Fluency**
		Entrepreneurial Literacy		**E,T,A**	**Accountability, Productivity and Ethics**

Unit 5: Thermal Energy

Instructional Days: 15

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, heat, 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.

Student Learning Objectives	
MS-PS3-3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
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-ETS1-3	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 Sequence and Pacing: Unit 3- Earth's Systems		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Temperature and Thermal Energy ● Temperature is a measure of the average kinetic energy of particles of matter. ● Thermal energy is the total amount of kinetic energy in an object. ● The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. ● As objects gain thermal energy the particles become more active, get further away from each other and the object expands. ● 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. ● 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.	Students who understand these concepts are able to: ● Define heat ● Differentiate between total kinetic energy and average kinetic energy ● Construct, use and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from and object Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Hot finger, cold finger lab ● Thermal Energy Stations ● BrainPOP: Temperature ● BrainPOP: Heat ● BrainPOP: Heat Transfer

Topic B: Heat Transfer ● Energy is spontaneously transferred out of hotter regions or objects and into colder ones. ● The transfer of energy can be tracked as energy flows through a designed or natural system. ● What we feel as hot and cold are actually the change in flow of thermal energy. ● Heat is thermal energy that is being transferred, objects cannot have heat.	Students who understand these concepts are able to: ● Plan an investigation to determine the relationship among the energy transferred, the type of matter, the mass and the change in the average kinetic energy of the particles as measured by temperature ● Apply scientific principles to design, construct and test a device that minimizes thermal energy transfer Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Popcorn Heat Transfer lab ● Hot Bolts Lab ● Heat Transfer Poster Project ● Insulator Project

Sample of Open Education Resources
Forms of Energy and Changes Explore how heating and cooling iron, brick, and water adds or removes energy. See how energy is transferred between objects. Build your own system, with energy sources, changers, and users. Track and visualize how energy flows and changes through your system. States of Matter Watch different types of molecules form a solid, liquid, or gas. Add or remove heat and watch the phase change. Change the temperature or volume of a container andsee pressure-temperature diagram responding real time. Relate the interaction potential to the forces between molecules **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Interdisciplinary Standard(s)

ELA/Literacy	Mathematics
● **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-PS3-5),MS-ETS1-1),(MS-ETS1-2),(MS-ETS1- 3) ● **RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4) ● **RST.6-8.7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in	● **MP.2** Reason abstractly and quantitatively.(MS-PS3-4),(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4) ● **6.SP.B.5** Summarize numerical data sets in relation to their context. (MS-PS3-4) ● **7.EE.3** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form;

a flowchart, diagram, model, graph, or table). (MS-PS3-3),(MS-PS3-4),(MS-ETS1-3) ● **RST.6-8.9** Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) ● **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2) ● **WHST.6-8.8** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) ● **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) ● **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4)	convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) ● **7.SP** Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-1: Asking Questions and Defining Problems ● 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	**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. (MS-PS3-	**CCC-1: Patterns** ● For objects of similar compositions (bolts made of the same material) more mass has the ability to hold more thermal energy at the same temperature (CCC-1)

solutions. Using bolts of various mass to explore the difference between temperature and thermal energy (SEP-1)

SEP-2: Developing and Using Models

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (SEP-2

SEP-3: Planning and Carrying Out Investigations

- 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. (SEP-3)

SEP-4: Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences in findings. Will determine the relationship between mass and thermal energy levels (SEP-4)

SEP-5: Using Mathematics and Computational Thinking

- Determine the mass of bolts and that mass's relationship to thermal energy held by an object (SEP-5)

3),(MS-PS3-4)

PS3.B: Conservation of Energy and Energy Transfer

- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)

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. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results,

CCC-2: Cause and Effect

- The transfer of thermal energy results in a change in kinetic energy (CCC-2)

CCC-3: Scale, Proportion, and Quantity

- Proportional relationships (e.g. mass of an object to the thermal energy it has). (CCC-3)

CCC-5: Energy and Matter

- The thermal energy an object has is a property it has due to kinetic energy of the atoms moving in an excited state. The conservation of energy from EME to thermal energy in the water to thermal energy in the bolt. (CCC-5)

CCC-6: Structure and Function

- The structure of an object has the ability to make it a good conductor or insulator (CCC-6)

SEP-6: Constructing Explanations and Designing Solutions ● Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (SEP-6) **SEP-7: Engaging in Argument from Evidence** ● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (SEP-7) **SEP-8: Obtaining, Evaluating, and Communicating Information** ● Complete a lab report with a written explanation of various energy levels relating it to the particle model (SEP-8)	in order to improve it. (MS-ETS1-4) ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) ● Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1- 3) ● Models of all kinds are important for testing solutions. (MS-ETS1-4) **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. (MS-ETS1-3) ● 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. (MS-ETS1-4)	

Technology Standard(s)
8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results

In this unit plan, the following Career Ready Practices are addressed:	
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	
	CRP1. Act as a responsible and contributing citizen and employee
E,T,A	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E,T,A	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
E,T,A	**CRP6. Demonstrate creativity and innovation**
E,T,A	**CRP7. Employ valid and reliable research strategies**
E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management

		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
		Environmental Literacy		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and			**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 6: Waves and the Electromagnetic Spectrum

Instructional Days: 20

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 interdisciplinary core ideas.

Student Learning Objectives	
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 Sequence and Pacing:		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Wave Properties ● A simple wave has a repeating pattern with a specific wavelength, frequency and amplitude. ● Describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. ● Graphs and charts can be used to identify patterns in data. ● Waves can be described with both qualitative and quantitative thinking.	Students who understand these concepts are able to: ● Explain what causes mechanical waves ● Describe the three types of mechanical waves ● Discover and explain how a wave's speed is related to its wavelength and frequency ● Describe how reflection, refraction and diffraction change a waves direction ● Model and explain different types of interference Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Hypothesize and investigate wave properties, by examining water waves in a lab ● Model waves using a slinky and explain the wave behaviors ● Wave speed practice ● Straw wave activty
Topic B: Light and Sound ● When light shines on an object, it is reflected, absorbed or transmitted through the object, depending on the object's material and frequency (color) of the light. ● The path that light travels can be traced as straight lines, except at	Students who understand these concepts are able to: ● Identify and explain the factors that affect the speed of sound ● Explain the factors that affect pitch and loudness ● Explain and model light waves Evidence of Student Learning: Common	● Hypothesize and examine what happens when light hits different sources ● Illustrate reflection and refraction of light waves and diffraction of sound wave ● Sound Waves Lab Stations ● Light and Lens activity ● Turn a Blind Eye Activity

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. ● Waves are reflected, absorbed, or transmitted through various materials. ● A sound wave needs a medium through which it is transmitted. ● Because light can travel through space, it cannot be a matter wave, like sound or water waves.	assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic C: Electromagnetic Spectrum ● The structure of a wave can be modified to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. ● Structures can be designed to use properties of waves to serve particular functions. ● Waves can be used for communication purposes. ● Digitized signals (wave pulses) are a more reliable way to encode and transmit information than are analog signals. ● Wave-related technologies extend the measurement, exploration, modeling and computational capacity of scientific investigations.	Students who understand these concepts are able to: ● Compare and contrast the electromagnetic waves Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Electromagnetic Spectrum Gizmo ● Electromagnetic Task Cards

Sample of Open Education Resources
Waves on a String (https://phet.colorado.edu/en/simulation/wave-on-a-string) Sound Waves (https://phet.colorado.edu/en/simulation/sound) Electromagnetic Waves for Kids (http://www.ducksters.com/science/physics/types_of_electromagnetic_waves.php) Electromagnetic Math (https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Electromagnetic_Math.html) Light and Color (http://www.physicsclassroom.com/class/light) Light and Color Video (http://www.pbslearningmedia.org/resource/lsps07.sci.phys.energy.lightcolor/light-and-color/) Mixing Primary Colors Online (http://www.omsi.edu/tech/colormix.php) **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation
• Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).

- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Anticipate where needs will be ● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3) ● **RST.6-8.2** - Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3) **RST.6-8.9** - Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3) ● **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1), (MS-PS4-2) ● **WHST.6-8.9** - Draw evidence from informational texts to support analysis reflection, and research. (MS-PS4-3)	**Mathematics** ● **6.RP.A.1** - Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1) ● **6.RP.A.3** - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-PS4-1) ● **7.RP.A.2** - Recognize and represent proportional relationships between quantities. (MS-PS4-1) ● **MP.2** - Reason abstractly and quantitatively. (MS-PS4-1) ● **MP.4** - Model with mathematics. (MS-PS4-1)

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
SEP- 2: Developing and Using Models Develop a model to describe phenomena. **(MS-PS4-2)** **SEP-5: Using Mathematics and Computational Thinking** Use mathematical representations to describe and/or support scientific conclusions and design solutions. **(MS-PS4-1)** **SEP-8: Obtaining, Evaluating, and Communicating Information** Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3) **Science Knowledge Is Based on Empirical Evidence** Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)	**PS4.A: Wave Properties** ● A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.(MS-PS4-1) ● 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) **PS4.C: Information Technologies and**	**CCC-1: Patterns** Graphs and charts can be used to identify patterns in data. (MS-PS4-1) **CCC-6: 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. **(MS-PS4-2)** Structures can be designed to serve particular functions. (MS-PS4-3) **Influence of Science, Engineering, and Technology on Society and the Natural World** Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3) **Science Is a Human Endeavor** Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

	Instrumentation • Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	

Technology Standard(s)
8.2.8.A.1- Research a product that was designed for a specific demand and identify how the product has changed to meet new demands **8.2.8.A.2-** Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system **8.2.8.C.3-** Evaluate the function, value and aesthetics of a technological product or system, from the perspective of the used and the producer

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
		CRP1. Act as a responsible and contributing citizen and employee
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**
		CRP5. Consider the environmental, social and economic impacts of decisions

		CRP6. Demonstrate creativity and innovation
		CRP7. Employ valid and reliable research strategies
	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
		Global Awareness		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**			**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and			**Communication and Media Fluency**

		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 7: Forces that Act a Distance

Instructional Days: 20

Unit Summary
Students have a general idea of objects being made of small particles but assume that these particles actually touch. For example a ball bouncing off the floor touches the ground. This unit will help students understand that EME actually keeps the particles from touching. Students use cause and effect; system and system models; and stability and change to understand ideas that explain why some materials are attracted to each other while others are not. Students apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students develop understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are expected to consider the influence of science, engineering, and technology on society and the natural world. Students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, designing solutions, and engaging in argument. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-PS2-3	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces
MS-PS2-4	Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems
MS-PS2-5	Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

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Unit Sequence and Pacing:		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Gravity • Fields exist between objects that exert forces on each other even though the objects are not in contact. • The interactions of magnets, electrically charged strips of tape, and electrically charged pith balls are examples of fields that exist between objects exerting forces on each other, even though the objects are not in contact. • Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object or a ball, respectively). • Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. • Gravitational interactions are always attractive and depend on the masses of interacting objects. • There is a gravitational force between any two masses, but it is very small except	Students who understand these concepts are able to: ● Explain and demonstrate while all masses accelerate towards Earth at the same rate, assuming zero air resistance. ● Explain how gravitational attraction is directly related to the mass and distance between objects. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Jump Lab (How high can I jump on other planets?) ● Center of Gravity Activities ● A Year in Space Doc

when one or both of the objects have large mass. • Evidence supporting the claim that gravitational interactions are attractive and depend on the masses of interacting objects could include data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the sun, and orbital periods of objects within the solar system.		
Topic B: Electricity and Magnetism • Factors affect the strength of electric and magnetic forces. • Devices that use electric and magnetic forces could include electromagnets, electric motors, and generators. • Electric and magnetic (electromagnetic) forces can be attractive or repulsive. • The size of an electric or magnetic (electromagnetic) force depends on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. • Cause-and-effect relationships may be used to predict the factors that affect the strength of electrical and magnetic forces in natural or designed systems	Students who understand these concepts are able to: ● Explain what causes electric fields and force ● Demonstrate how static electricity is different from a current ● Describe how you can change the magnetic force and potential energy between objects ● Model how electricity is related to magnetism ● Explain and model how a current can be produced in a conductor Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, running records, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	● Complete the circuit activity ● Magnetism Gizmo ● John Tra-voltage Phet ● Static Activities

Sample of Open Education Resources
McDougall/Littell “Electricity and Magnetism” Carolina Scientific Electricity and Magnetism Kit Phet Circuit building Phet balloon electricity **Textbooks used but not limited to:** Pearson Realize Elevate Discovery Science

Modifications and Differentiation
● Structure lessons around questions that are authentic, relate to students’ interests, social/family background and knowledge of their community. ● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). ● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue. ● Provide ELL students with multiple literacy strategies.

- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. *(MS-PS2-1),(MS-PS2-3)* ● RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. *(MS-PS2-1),(MS-PS2-2),(MS-PS2-5)* ● **WHST.6-8.1** Write arguments focused on *discipline-specific content*. (MS-PS2-4) ● **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. *(MS-PS2-1)*,(MS-PS2-2),*(MS-PS2-5)*	**Mathematics** ● **MP2 -** Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-1: Asking Questions and Defining Problems ▯ Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (SEP-1)	**PS2.B: Types of Interactions** ● Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5) ● Electric and magnetic	**CCC-1: Patterns** ▯ The distance objects are affects their EME interaction (CCC-1) **CCC-2: Cause and Effect** ▯ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (CCC-2)

SEP-3: Planning and Carrying Out Investigations - 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. (SEP-3) - Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (SEP-3) **SEP-4: Analyze and Interpret Data** ❖ Data related to the construction of DC motors, electro magnets, and activities involving static electricity (SEP-4) **SEP-6: Constructing Explanations and Designing Solutions** - Apply scientific ideas or principles to design an object, tool, process or system. (SEP-6) **SEP-7: Engaging in Argument from Evidence** - Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (SEP-7) **SEP-8: Obtaining, Evaluating, and**	(electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) • Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)	**CCC-3: Scale, Proportion and Quantity** Similar relationship between distance and interaction (CCC-3) **CCC-4: 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. (CCC-4) **CCC-5: Energy and Matter** - EME is a quality due to the interaction of particles and is conserved (the energy that makes a light bulb glow is energy generated from other forms) (CCC-5) **CCC-6: Structure and Function** - Not all objects can conduct EME (insulators) due to their physical properties (CCC-6) **CCC-4: Stability and Change** - Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (CCC-4)

Communicating Information ▯ Written explanations based on scientific observations (SEP-8)		

Technology Standard(s)
8.1.8.A.4 Graph and calculate data in a spreadsheet 8.1.8.A.3 Use simulation that provides an environment for solving a real life problem

In this unit plan, the following Career Ready Practices are addressed:		
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		CRP1. Act as a responsible and contributing citizen and employee
		CRP2. Apply appropriate academic and technical skills
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**
		CRP5. Consider the environmental, social and economic impacts of decisions
	E,T,A	**CRP6. Demonstrate creativity and innovation**
	E,T,A	**CRP7. Employ valid and reliable research strategies**

		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		E,T,A	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and			**Communication and Media Fluency**
		Entrepreneurial Literacy		**E,T,A**	**Accountability, Productivity and Ethics**

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Earth and Space Sciences				
MS-ESS1 Earth's Place in the Universe				
MS-ESS1-1	**Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.**	**X**		
MS-ESS1-2	**Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.**	**X**		
MS-ESS1-3	**Analyze and interpret data to determine scale properties of objects in the solar system.**	**X**		
MS-ESS1-4	**Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.**	**X**		
MS-ESS2 Earth's Systems				
MS-ESS2-1	**Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.**	**X**		
MS-ESS2-2	**Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.**	**X**		
MS-ESS2-3	**Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.**	**X**		
MS-ESS2-4	**Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.**	**X**		
MS-ESS2-5	**Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.**	**X**		
MS-ESS2-6	**Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.**	**X**		
MS-ESS3 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.**	**X**		
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.**	**X**		
MS-ESS3-3	**Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.**	**X**		
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.**	**X**		
MS-ESS3-5	**Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.**	**X**		

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Life Science				
MS-LS1 From Molecules to Organisms: Structures and Processes				
MS-LS1-1	**Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.**			**X**
MS-LS1-2	**Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.**			**X**
MS-LS1-3	**Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.**			**X**
MS-LS1-4	**Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.**			**X**
MS-LS1-5	**Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.**			**X**

MS-LS1-6	**Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.**			**X**
MS-LS1-7	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as the matter moves through organism.**			**X**
MS-LS1-8	**Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.**			**X**
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics				
MS-LS2-1	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.**			**X**
MS-LS2-2	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**			**X**
MS-LS2-3	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.**			**X**
MS-LS2-4	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.**			**X**
MS-LS2-5	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services.**			**X**
MS-LS3 Heredity: Inheritance and Variation of Traits				
MS-LS3-1	**Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.**			**X**
MS-LS3-2	**Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.**			**X**

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Life Science				
MS-LS4 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.**			**X**
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.**			**X**
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.**			**X**
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.**			**X**
MS-LS4-5	**Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.**			**X**
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.**			**X**

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Physical Science				
MS-PS1 Matter and Its Interactions				
MS-PS1-1	**Develop models to describe atomic composition of simple molecules and extended structures.**		**x**	
MS-PS1-2	**Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.**		**x**	
MS-PS1-3	**Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.**		**x**	
MS-PS1-4	**Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.**		**x**	
MS-PS1-5	**Develop and use a model to describe how the total number of atoms does not change chemical reaction and thus mass is conserved.**		**x**	
MS-PS1-6	**Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.**		**x**	
MS-PS2 Motion and Stability: Forces and Interactions				
MS-PS2-1	**Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**		**X**	
MS-PS2-2	**Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.**		**X**	
MS-PS2-3	**Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.**		**X**	
MS-PS2-4	**Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting**		**X**	**X**

	objects.			
MS-PS2-5	**Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**		**X**	
MS-PS3 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.**		**X**	
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.**		**X**	
MS-PS3-3	**Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer**		**X**	
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.**		**X**	
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.**		**X**	

STANDARD	**PERFORMANCE EXPECTATION**	6^{TH} GRADE	7^{TH} GRADE	8^{TH} GRADE
Physical Science				
MS-PS4 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.**		**X**	
MS-PS4-2	**Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.**		**X**	

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.**		**X**	

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Engineering Design				
MS – ETS1 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.**	**X**	**X**	**X**
MS-ETS1-2	**Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**		**X**	**X**
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.**	**X**	**X**	**X**
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.**		**X**	

Middle Township

Middle School

8th Grade

Science

Curriculum

Table of Contents

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PHILOSOPHY AND GOALS

This document serves to meet all requirements for curriculum as per the Middle Township Board of Education and the New Jersey Department of Education and will serve as a guide for lesson planning. Units within the curricular framework for science are designed to be taught in the order in which they are presented. Within the units, the teachers have flexibility of what order to present the standards. Suggested Science and Engineering Practice Standards and Cross-Cutting Concepts are listed in each unit to be embedded regularly in daily science instruction.

Middle School science in Middle Township Public School district is interdisciplinary and covers all four domains of the Next Generation Science Standards: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science. The goal of science education curriculum is to produce students who have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives. They should come to appreciate that science and the current scientific understanding of the world are the result of many hundreds of years of creative human endeavor. It is especially important to note that the above goals are for all students, not just those who pursue careers in science, engineering, or technology or those who continue on to higher education (p. 9, NRC, 2012).

Given this goal, an integrated science curriculum model should drive the formation of middle school science curriculum because:

- The nature of science is complex and multidisciplinary.
- Learning theory research in science shows expert knowledge base develops better through interdisciplinary connections and not through isolated content.
- Effective research-based practices for curriculum and instruction in science and engineering are supported through this approach.
-

The nature of science is complex and multidisciplinary. From research about how scientists work, we know that scientists do not work in isolation in their own house of physics, or biology or chemistry but they reach out and create networks of scientists within and across disciplines who can contribute understanding, share ideas, and critique evidence and explanations. As we see in the science of global climate change, scientists work across the fields of geology, physics, and biology to provide evidence, plan investigations, and develop models to represent new ways to think about Earth systems. Important

practices like engaging in argument from evidence, modeling, and communicating information do not occur in isolation but rely on feedback from within and across scientific communities and disciplines. Basing the middle school model curriculum in an integrated model where the students are engaged with a variety of topics at each grade, focused on the connection of ideas across the domains, enhances the interdisciplinary nature of science.

In the elementary years, students build their understanding of core concepts across all three domains of science: physical, life and Earth and space. Continuing this model in grades 6-8 better supports student learning in that there will not be a large gap of time in which a student does not engage in a specific discipline. This model takes advantage of current research which recognizes that there is variation across children at a given age and that thinking does not develop along a preset roadmap for each student. It allows middle school students to build on what they know and think they understand from their elementary years with the goal in middle school of helping students to revise their knowledge and understanding about those core ideas. Learning theory research shows expert knowledge base develops better through interdisciplinary real-world connections than through isolated content. This is especially important in middle school where motivation is critical to learning. An integrated and better articulated middle school model science curriculum that reflects what we know currently about how children learn science and how their mastery develops over time promotes deeper learning in science. As we know and understand about how students develop understanding while learning content, it informs teachers' practice; if teachers understand where their students are in their understanding of core ideas, and anticipate what students' misconceptions and struggles may be, they are better able to differentiate instruction and provide scaffolding that allows students to develop an integrated and deeper understanding of the science.

DIVERSITY AND INCLUSION

In alignment with the New Jersey Student Learning Standards, the Science curriculum materials will:

- Cultivate respect towards minority groups to foster appreciation of their differences as well as recognizing their contributions to the advancement of science and technology.

- Evaluate experiences of people of diverse backgrounds and their unique journeys, including challenges and successes, and their significant historic contributions to the scientific, economic, political, and social development of New Jersey and the United States.

- Analyze grade-level texts highlighting the technological and scientific contributions of persons of different genders, ethnicities, and abilities.

- Apply the critical thinking process to develop empathy, challenging biases, to better understand different perspectives and experiences to

creatively problem-solve and innovate solutions for diverse groups of people with specific needs.

● Engage in authentic learning experiences that enable students to acquire and incorporate varied perspectives, and to communicate with diverse audiences while applying content knowledge, integrating concepts across disciplines, and developing scientific thinking skills.

● Participate in an inclusive and diverse scientific culture that appreciates and incorporates perspectives from people of different genders, ethnicities, and abilities.

● Understand how scientific, economic, political, social, and cultural aspects of society drive development of new scientific and technological products, processes, and systems.

● Reflect on personal experiences and the experiences of others building empathy and promoting a climate of respect and acceptance of people with different backgrounds and abilities.

Three Dimensions of the Next Generation Science Standards

The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence- based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires. Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and

function; Stability and change. The Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.

Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
- Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
- Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;
- Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

8th Grade Life Science and Pacing Guide			
Unit of Study	**Concepts**	**NGSS**	**Instructional Days**
Unit 1- Cells: The Basic Unit of Life	A: Structure & Function of Cells B: Cell Structures C: Obtaining & Removing Materials D: Cell Division E: Photosynthesis & Cellular Respiration	MS-LS1-1 MS-LS1-2 MS-LS1-6	20 days
Unit 2- Body Systems	A: Body Organization & System Interactions B: Supplying Energy	MS-LS1-3 MS-LS1-7	30 days

	C: Circulation D: Respiration & Excretion E: Muscular & Nervous System	MS-LS1-8	
Unit 3- Growth, Development and Reproduction of Organisms	A: Patterns of Reproduction B: Plant Structures for Reproduction C: Animal Behaviors for Reproduction D: Adaptations for Survival E: Factors Influencing Growth	MS-LS1-4 MS-LS1-5 MS-ETS1-2	20 days
Unit 4- Inheritance and Variations of Traits	A: Patterns of Inheritance B: Chromosomes and Inheritance C: Genetic Coding and Protein Synthesis D: Trait Variation E: Genetic Technology	MS-LS3-1 MS-LS3-2 MS-ETS1-1	15 days
Unit 5- Selection and Adaptation	A: Darwin's Theory B: Natural Selection C: Evidence of Evolution D: Rate of Change	MS-LS4-4 MS-LS4-5 MS-LS4-6	20 days
Unit 6- Ecology	A: Living Things & the Environment B: Populations	MS-LS2-1 MS-LS2-2	25 days

	C: Energy Flow in Ecosystems D: Interactions Among Living Things	MS-LS2-3 MS-ETS1-3	
Unit 7- Biodiversity and Humans	A: Biodiversity B: Human Effect C: Environmental Protection	MS-LS2-4 MS-LS2-5 MS-ETS1-1 MS-ETS1-3	15 days

Unit 1- Cells: The Basic Unit of Life

Instructional Days: 20

Unit Summary
How do cells contribute to the functioning of an organism? Students demonstrate age appropriate abilities to plan and carry out investigations to develop evidence that living organisms are made of cells. Students gather information to support explanations of the relationship between structure and function in cells. They are able to communicate an understanding of cell theory and understand that all organisms are made of cells. Students understand that special structures are responsible for particular functions in organisms. They then are able to use their understanding of cell theory to develop and use physical and conceptual models of cells. The crosscutting concepts of scale, proportion, and quantity and structure and function provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in planning and carrying out investigations, analyzing and interpreting data, and developing and using models. Students are also expected to use these science and engineering practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]
MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]
MS-LS1-6	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

Unit Sequence and Pacing: Unit 1- Cells: The Basic Unit of Life		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Structure & Function of Cells ● Cells are the smallest unit of life that can be said to be alive. ● All living things are made of cells, either one	Students who understand concepts will be able to: ● State the parts of the Cell Theory ● Compare and contrast prokaryotic and eukaryotic cells	-Comparing cells under a microscope -Pond Water Lab

cell or many different numbers and types of cells. ● Nonliving things can be composed of cells., from once-living things that have died. ● Organisms may consist of one single cell (unicellular) or many different types and numbers of cells (multicellular). ● Engineering advances have led to important discoveries in the field of cells.	● Explain how the invention of the microscope influenced the Cell Theory ● Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic B: Cell Structures ● The cell functions as a whole system. ● Within cells, special structures are responsible for particular functions (organelles- nucleus, chloroplasts, mitochondria, cell membrane, golgi apparatus, endoplasmic reticulum, etc.) ● A model can be used to describe the function of a cell as a whole. ● A model can be used to describe how parts of cells contributed to the cell's function. ● The structures of the cell wall and cell membrane are related to their function.	Students who understand concepts will be able to: ● Compare and contrast plant and animal cells. ● Develop and use a model to describe the functions of parts of the cell and how they contribute to the function of a cell as a whole. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Cell School Analogy -Edible Cell Project -Cell Choice Assignments -Organelle "Spoons" Game
Topic C: Obtaining & Removing Materials ● Within cells, the cell membrane forms the boundary that controls what enters and leaves the cell.	Students who understand concepts will be able to: ● Develop and use a model to describe how cells obtain energy and remove waste materials through the cell membrane. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and	-Gummy Bear Osmosis Lab -Tea experiment -Active Transport Game

	laboratory investigations.	
Topic D: Cell Division ● Cell division has a cause and effect relationship. ● Cells divide in a predictable pattern and the number of cells can be calculated when the number of divisions is provided.	Students who understand concepts will be able to: ● Restate the four functions of cell division. ● Model and explain each phase of the cell cycle. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Oreo/Sprinkles Mitosis -Cell Cycle Puzzle -Cell Division Gizmo
Topic E: Photosynthesis & Cellular Respiration ● Photosynthesis plays a role in the cycling of materials and energy through ecosystems. ● Cells can release energy with or without using oxygen.	Students who understand concepts will be able to: ● Identify the roles of light, carbon dioxide, water, and oxygen in photosynthesis. ● Justify and provide evidence of how plants and other organisms use photosynthesis to make food. ● Model how organisms use cellular respiration to break down food to provide energy. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-3d Leaf Model -Homemade Ginger Ale -Chloroplast under a microscope

Sample of Open Education Resources

Cells Alive

A Busy Factory Website

Lab 4: Cell Structure, from "Argument-Driven Inquiry in Life Science"

List of textbooks but not limited to:

Pearson Realize Elevate Science

Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
SEP- 2: Developing and Using Models ● Develop a model to describe phenomena. (MS-LS1-2) **SEP-3: Planning and Carrying Out Investigations** ● Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1) **SEP-7: Engaging in Argument from Evidence** ● Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3) **SEP-8: Obtaining, Evaluating, and Communicating Information** ● 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. (MS-LS1-8)	**LS1.A: Structure and Function** ● All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1) ● Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)	**CCC-3: Scale, Proportion, and Quantity** ● Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) **CCC-6: Structure and Function** ● Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2) **CCC-4: Interdependence of Science, Engineering, and Technology** ● Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1) **Science Is a Human Endeavor** ● Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity,

		skepticism, and openness to new ideas. (MS-LS1-3)

Technology Standard(s)
8.1.8.D.4-Assess the credibility and accuracy of digital content **8.1.8.E.1-** Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem **8.2.8.C.1-** Explain how different teams/groups can contribute to the overall design of a product **8.2.8.C.2-** Explain the need for optimization in a design process **8.2.8.C.4-** Identify the steps in the design process that would be used to solve a designated problem

Interdisciplinary Standard(s)	
ELA/Literacy • **RI.6.8** - Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3) • **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3) • **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2) • WHST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3) • WHST.6-8.8 - Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS1-8)	**Mathematics** • 6.EE.C.9 - Use variables to represent two quantities, such as the number of cells that make up an organism and units representing the size or type of the organism and determine the relationship between these two variables. Use variables to help determine the ratio of the cell's surface area to its volume. (MS-LS1-1), (MS-LS1-2), (MS-LS1-3)

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being

	E,T,A	**CRP4. Communicate clearly and effectively with reason**
		CRP5. Consider the environmental, social and economic impacts of decisions
	E,T,A	**CRP6. Demonstrate creativity and innovation**
	E,T	**CRP7. Employ valid and reliable research strategies**
	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	E,T,A	**CRP9. Model integrity, ethical leadership and effective management**
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

Check all that apply. **21st Century Themes**			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
		Global Awareness		**E,T,A**	**Critical Thinking & Problem Solving**
		Environmental Literacy		**E,T,A**	**Creativity and Innovation**
	X	**Health Literacy**		**E,T,**	**Collaboration, Teamwork and Leadership**

				A	
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and			**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 2- Body Systems

Instructional Days: 30

Unit Summary
In this unit students develop a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. Students will construct explanations for the interactions of systems in cells and organisms. Students understand that special structures are responsible for particular functions in organisms, and that for many organisms, the body is a system of multiple- interaction subsystems that form a hierarchy, from cells to the body. Students construct explanations for the interactions of systems in cells and organisms and for how organisms gather and use information from the environment. The crosscutting concepts of systems and system models and cause and effect provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in engaging in argument from evidence and obtaining, evaluating, and communicating information. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Student Learning Objectives	
MS-LS1-3	Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
MS-LS1-8	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Unit Sequence and Pacing: Unit 2- Body Systems		
Concepts	**Assessments** **(Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Body Organization & System Interactions ● In multicellular organisms, the body is a system of multiple, interacting subsystems. ● Subsystems are group of cells that work together to form tissues. ● Organs are groups of tissues that work together to form a particular body function. ● Tissues and organs are specialized for particular body functions. ● Systems may interact with other systems. ● Systems may have subsystems and be part of larger complex systems. ● Interactions are limited to the circulatory, excretory, digestive, respiratory, muscular and nervous system.	Students who understand concepts will be able to: ● List the levels of organization within the body. ● Elaborate on how humans carry out life processes including movement, respiration, digestion, and circulation. ● Explain how body systems interact to maintain homeostasis. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Homeostasis Exercise Lab -Body diagram anticipatory activity -Body System Netflix Project

Topic B: Supplying Energy ● The body needs important nutrients to carry out its processes. ● The body's systems process foods into materials it can use.	Students who understand concepts will be able to: ● Examine the path food travels. ● Compare and contrast mechanical and chemical digestion. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Digestive System Gizmo -Breakdown Lab -Digestion Station -Small Intestine Fat Digestion Lab
Topic C: Circulation ● Body systems interact to transport materials throughout the body. ● The circulatory system uses blood vessels including veins, arteries, and capillaries to interact with other systems.	Students who understand concepts will be able to: ● Sequence the path blood flows through the body. ● Describe the structure and function of blood vessels. ● Construct a model of human blood and explain its components. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Parts of Blood Model -Circulation Play -Blood Typing Lab -Weird Animal Hearts Venn Diagram
Topic D: Respiration and Excretion ● The respiratory system interacts with other systems to exchange gasses. ● Other body systems interact with the excretory system to remove wastes.	Students who understand concepts will be able to: ● Identify and explain the products and reactants of cellular respiration. ● Build a model of the excretory system and explain the parts along with their corresponding functions.	-Respiratory System Graphic Organizers -Lung Capacity Lab -Excretory System Model -Excretion EdPuzzle

	Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic E: The Muscular & Nervous Systems ● Sense receptors respond to different inputs (electromagnetic, mechanical, chemical). ● Sense receptors transmit responses as signals that travel along nerve cells to the brain. ● Signals are then processed in the brain. ● Brain processing results in immediate behaviors or memories. ● Cause-and-effect relationships may be used to predict response to stimuli in natural systems.	Students who understand concepts will be able to: ● Distinguish between voluntary and involuntary movements. ● Compare and contrast the three types of muscles. ● Provide examples that show how sensory information is processed by the brain as memories and behavior. ● Gather and process information that sensory receptors respond to stimuli by sending messages to the brain. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Muscles under a microscope -Cotton Eye Lab -Counting Numbers Activity -Falling Sticks Activity

Sample of Open Education Resources
SEPUP Body Works Activities NOVA body + brain Website Animal Communications Website No Ordinary Coronary ***List of textbooks but not limited to:*** Pearson Realize Elevate Science Discovery Science

Modifications and Differentiation
● Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. ● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). ● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue. ● Provide ELL students with multiple literacy strategies. ● Collaborate with after-school programs or clubs to extend learning opportunities.

- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Science and Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
SEP-8: Obtaining, Evaluating, and Communicating Information ☐ 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. (MS-LS1-8) **SEP-7: Engaging in Argument from Evidence** ☐ Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)	**LS1.A: Structure and Function** ● In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3) **LS1.D: Information Processing** ● Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)	**CCC-2: Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) **CCC-4: Systems and System Models** ● Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3) **Science Is a Human Endeavor** ● Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3) ● skepticism, and openness to new ideas. (MS-LS1-3)

Technology Standard(s)
8.1.8.E.1- Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem **8.1.8.F.1-** Plan and manage activities to develop a solution or complete a project

Interdisciplinary Standard(s)

ELA/Literacy

- **RI.6.8** - Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3)
- **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3)
- **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2)
- **WHST.6-8.8** - Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS1-8)

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**
	E,T,A	**CRP5. Consider the environmental, social and economic impacts of decisions**
		CRP6. Demonstrate creativity and innovation
	E,T	**CRP7. Employ valid and reliable research strategies**

	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
		Global Awareness		**E,T,A**	**Critical Thinking & Problem Solving**
		Environmental Literacy			**Creativity and Innovation**
	X	**Health Literacy**		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and			**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 3- Growth, Development, & Reproduction

Instructional Days: 20

Unit Summary
Students use data and conceptual models to understand how the environment and genetic factors determine the growth of an individual organism. They connect this idea to the role of animal behaviors in animal reproduction and to the dependence of some plants on animal behaviors for their reproduction. Students provide evidence to support their understanding of the structures and behaviors that increase the likelihood of successful reproduction by organisms. The crosscutting concepts of cause and effect and structure and function provide a framework for understanding the disciplinary core ideas. Students demonstrate grade-appropriate proficiency in analyzing and interpreting data, using models, conducting investigations, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-LS1-4	Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Unit Sequence and Pacing: Unit 3- Growth, Development and Reproduction of Organisms		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Patterns of Reproduction ● Genetic factors as well as local conditions affect the growth of an organism.	Students who understand concepts will be able to: ● Compare and contrast asexual and sexual reproduction. ● Identify the difference between inherited and acquired traits. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Acquired traits Pixton Comic -Inherited traits Project
Topic B: Plant Structures for Reproduction ● Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features of reproduction. ● Specialized structures for plants affect their probability of successful reproduction. ● Some characteristic animal behaviors affect the probability of successful reproduction in plants.	Students who understand concepts will be able to: ● Describe plant structures that affect the probability of reproduction. ● Use evidence to explain how plant structures affect the probability of successful reproduction. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Plant dissection -Leaves under a microscope -Plant anatomy model
Topic C: Animal Behaviors for Reproduction	Students who understand concepts will be able to:	-Avian Artists case study

● Animals engage in characteristic behaviors that affect the probability of successful reproduction. ● There are a variety of characteristic animal behaviors that affect their probability of successful reproduction. ● There are a variety of animal behaviors that attract a mate.	● Compare and contrast internal and external fertilization. ● Use evidence to explain how animals use specific behaviors to increase their chances of survival and reproduction. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Animal Behavior CER -Peppercorn fertilization Quick Lab
Topic D: Adaptations for Survival ● Successful reproduction of animals and plants may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.	Students who understand concepts will be able to: ● Categorize an animal's adaptation as behavior, physical, or physiological and justify the reasoning with evidence. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	-Butterfly camouflage challenge -Teeth adaptation flippable -Amazing Adaptations movie -Adaptation Olympics
Topic E: Factors Influencing Growth ● The factors that influence the growth of organisms may have more than one cause. ● Some cause-and-effect relationships in plant and animal systems can only be described using probability.	Students who understand concepts will be able to: ● Construct an explanation using evidence for how environmental and genetic factors influence the growth and development of organisms. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student	-Amniotic Egg Model -Chicken egg dissection -Raise mealworms into beetles (metamorphosis)

	conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	

Sample of Open Education Resources
Investigating Reproductive Strategies Plants and Animals, Partners in Pollination Reproduction Effect of Environment on Plant Growth Concord PhET ***List of textbooks but not limited to:*** Pearson Realize Elevate Science Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-6: Constructing Explanations and Designing Solutions - 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. (MS-LS1-5) **SEP-7: Engaging in Argument from Evidence** - Use an oral and written argument supported by empirical evidence and	**LS1.B: Growth and Development of Organisms** ● Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4) ● Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4) ● Genetic factors as well as local conditions affect the growth of the adult plant. (MS-	**CCC-2: Cause and Effect** - Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) - Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.(MS-LS1-4), (MS-LS1-5), (MS-LS4-5)

scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4) **SEP-8: Obtaining, Evaluating, and Communicating Information** 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. (MS-LS4-5)	LS1-5) • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*	**CCC-6: Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Technology Standard(s)
8.1.8.A.3- Use and/or develop a simulation that provides an environment to solve a real world problem or theory **8.1.8.D.4-** Assess the credibility and accuracy of digital content

Interdisciplinary Standard(s)	
ELA/Literacy ● **RI.6.8** - Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-4) ● **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4), (MS-LS1-5), (MS-LS3-1), (MS- LS3-2), (MS-LS4-5) ● **RST.6-8.2** - Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5) ● **RST.6-8.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. (MS-LS3-1), (MS-LS3-2) ● **RST.6-8.7** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually(e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1), (MS-LS3-2) ● **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1), (MS-LS3-2) ● **WHST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4) ● **WHST.6-8.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS1-5) ● **WHST.6-8.8** - Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data while avoiding plagiarism and following a standard format for citation. ● **WHST.6-8.9** - Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5)	**Mathematics** ● **6.SP.A.2** - Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4), (MS-LS1-5) ● **6.SP.B.5** - Summarize numerical data sets in relation to their context. (MS-LS3-2)

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
		CRP1. Act as a responsible and contributing citizen and employee
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**
	E,T,A	**CRP5. Consider the environmental, social and economic impacts of decisions**
	E,T,A	**CRP6. Demonstrate creativity and innovation**
		CRP7. Employ valid and reliable research strategies
	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	E,T,A	**CRP9. Model integrity, ethical leadership and effective management**
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills		
		Global Awareness		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and			**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 4- Inheritance and Variations of Traits

Instructional Days: 15

Unit Summary
Students develop and use models to describe how gene mutations and sexual reproduction contribute to genetic variation. Students understand how genetic factors determine the growth of an individual organism. They also demonstrate understanding of the genetic implications of sexual and asexual reproduction. The crosscutting concepts of cause and effect and structure and function provide a framework for understanding how gene structure determines differences in the functioning of organisms. Students are expected to demonstrate proficiency in developing and using models. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Student Learning Objectives	
MS-LS3-1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
MS-LS3-2	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
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 Sequence and Pacing: Unit 4- Inheritance and Variations of Traits		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Patterns of Inheritance ● Complex and microscopic structures and systems, such as genes located on chromosomes, can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among the parts of the system; therefore, complex natural structures/systems can be analyzed to determine how they function.	Students who understand concepts will be able to: ● Identify Gregor Mendel's contributions to genetics and inheritance. ● Describe how variations of traits between parents and offspring arise from variations between genes from each parent. ● Develop a model to predict the probability of inheritance of specific genetic variations. ● Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student	Genetic Monster Family Project Punnett Squares Marble Genetic Crossing

	conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic B: Chromosomes and Inheritance ● Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. ● Organisms reproduce either sexually or asexually and transfer their genetic information to their offspring. ● Asexual reproduction results in offspring with identical genetic information. ● Sexual reproduction results in offspring with genetic variation. ● Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.	Students who understand concepts will be able to: ● Compare and contrast meiosis and mitosis. ● Differentiate between genes, alleles, and chromosomes and determine how they are related to inheritance. ● Demonstrate the influence of pedigree on variations in inherited traits across generations. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Chromosome Chaos Lab Meiosis Model
Topic C: Genetic Coding and Protein Synthesis ● Each distinct gene chiefly controls the production of specific proteins, which in turn affect the traits of the individual. ● Changes in genetic material may result in the production of different proteins. ● Though rare, mutations may result in changes to the structure and function of proteins.	Students who understand concepts will be able to: ● Describe why cells undergo DNA replication. ● Develop models to explain how cells make proteins. ● Use models to explain why cells undergo protein synthesis. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and	Build RNA Model DNA Extraction (Strawberry) Lab

	laboratory investigations.	
Topic D: Trait Variations ● In addition to variations that arise from sexual reproduction, genetic information can be altered due to mutations. ● Some changes to genetic material are beneficial, others harmful, and some neutral to the organism. ● Punnett squares, diagrams, and simulations can be used to describe the cause-and-effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation. ● In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring.	Students who understand concepts will be able to: ● Construct explanations by determining sex-linked inheritance using a Punnett Square. ● Analyze sex-linked chromosomal indiacations of diseases. ● Construct a model to show how genetic mutations occur. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Mutation Card Sort Genetic Mutation Research Project
Topic E: Genetic Technology ● Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. ● Some changes to genetic material are beneficial, others harmful, and some neutral to the organism. ● In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. ● In artificial selection, humans choose desirable, genetically determined traits to pass on to offspring.	Students who understand concepts will be able to: ● Synthesize information to explain how humans use artificial selection to produce organisms with desired traits. ● Explain how scientists engineer new genes. ● Use information to support how genetic information can be used. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	BrainPop Sally the Sheep

Sample of Open Education Resources

Using Blood Types for Identification

Investigating Reproductive Strategies

Junior's Family Tree

Monstrous Mutations Adaptation: Mutations & Variations Activity

Dominant or Recessive?

List of textbooks but not limited to:

Pearson Realize Elevate Science

Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.

- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP 2 - Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2)	**LS1.B: Growth and Development of Organisms** ● Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)* ● **LS3.A: Inheritance of Traits** ● Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3- 1) ● Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** ● In sexually reproducing organisms, each parent contributes half of the genes	**CCC-2: Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) **CCC-6: Structure and Function** ● Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

	acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) • In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	

Technology Standard(s)
8.1.8.E.1 Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem. **8.2.8.D.1** Design and create a product that addresses a real world problem using a design process under specific constraints. **8.2.8.D.2**Identify the design constraints and trade-offs involved in designing a prototype (e.g., how the prototype might fail and how it might be improved) by completing a design problem and reporting results in a multimedia presentation, design portfolio or engineering notebook. **8.2.8.B.1** Build a prototype that meets a STEM-based design challenge using science

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4), (MS-LS1-5), (MS-LS3-1), (MS- LS3-2), (MS-LS4-5) ● **RST.6-8.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics. (MS-LS3-1), (MS-LS3-2) ● **RST.6-8.7** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1), (MS-LS3-2) ● **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1), (MS-LS3-2)	**Mathematics** ● **6.SP.B.5** - Summarize numerical data sets in relation to their context. (MS-LS3-2) ● **MP.4** - Model with mathematics. (MS-LS3-2)

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
		CRP1. Act as a responsible and contributing citizen and employee
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**

	E,T,A	**CRP5. Consider the environmental, social and economic impacts of decisions**
	E,T,A	**CRP6. Demonstrate creativity and innovation**
		CRP7. Employ valid and reliable research strategies
	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	E,T,A	**CRP9. Model integrity, ethical leadership and effective management**
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	X	**Global Awareness**		**E, T, A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		**E**	**Creativity and Innovation**
		Health Literacy		**E**	**Collaboration, Teamwork and Leadership**

		Civic Literacy		**E,T**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 5- Selection and Adaptation

Instructional Days: 20

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.

Student Learning Objectives	
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 Sequence and Pacing: Unit 5- Selection and Adaptation		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Darwin's Theory ● Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment.	Students who understand concepts will be able to: ● Explain Darwin's hypothesis. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Bird Beak Activity (Mouse) Nature at Work Lab
Topic B: Natural Selection ● Natural selection leads to the predominance of certain traits in a population and the suppression of others. ● Natural selection may have more than one cause, and some cause-and-effect relationships within natural selection can only be described using probability. ● Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions. ●	Students who understand concepts will be able to: ● Explain how the genetic variations of traits in a population will increase some individual's probability reproduction in a specific environment. ● Give examples of genetic variations in traits in a population. ● Construct an explanation based on evidence that describes how genetic variations of traits in a population increase chances of survival.	M&M Natural Selection Lab Natural Selection Gizmo Extinction vs. Natural Selection Project

	Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic C: Evidence of Evolution ● The distribution of traits in a population changes. ● Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. ● Mathematical representations can be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	Students who understand concepts will be able to: ● Gather and synthesize information about technologies that have changed the ways humans influence the inheritance of desired traits. ● Describe evidence that supports evolution. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Birds on the Island Investigation Adaptation Task Cards
Topic D: Rate of Change ● In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. ● Phenomena, such as genetic outcomes in artificial selection, may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.	Students who understand concepts will be able to: ● Explain the patterns that describe the rate of evolution. ● Model the process in which new species form. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Evolution Gizmo Anatomical Evidence of Evolution Lab

Sample of Open Education Resources

Genetics of Sesame Street Characters A Recipe for Traits

Dragon Genetics – Understanding Inheritance

Monstrous Mutations Adaptation: Mutations & Variations Activity

99.99% Antibacterial Products and Natural Selection

Clipbirds

Bug Hunt

List of textbooks but not limited to:

Pearson Realize Elevate Science

Discovery Science

Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from

the community helping with a project, journal articles, and biographies).

- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	**ELL**	**RTI/Students at Risk of Failure**	**Accelerated Students**
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

● Anticipate where needs will be ● Break down into smaller increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP 6 - Constructing Explanations and Designing Solutions Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4) **SEP 8 - Obtaining, Evaluating, and Communicating Information** 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. (MS-LS4-5) **Using Mathematics and Computational Thinking** Use mathematical representations to support scientific conclusions and design solutions. (MS- LS4-6)	**LS4.B: Natural Selection** Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) 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 on to offspring. (MS-LS4-5) **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. (MS-LS4-6)	**CCC-2: Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)

Technology Standard(s)
8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools. **8.1.8.A.3** Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

Interdisciplinary Standard(s)	
ELA/Literacy ● **RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-4),(MS- LS4-5**)** ● **RST.6-8.9** Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. *(MS-LS4-4)* ● **WHST.6-8.2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. *(MS-LS4-4)* ● **WHST.6-8.8**Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5) ● **WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-4) ● **SL.8.1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-4) ● **SL.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. (MS-LS4-4)	**Mathematics** ● **MP.4** Model with mathematics. (MS-LS4-6) ● **6.SP.B.5** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4),(MS-LS4-6) 6.RP.A.1 Summarize numerical data sets in relation to their context. (MS-LS4-4),(MS-LS4-6) ● **7.RP.A.2** Recognize and represent proportional relationships between quantities. (MS-LS4-4),(MS-LS4-6)

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
	E	**CRP1. Act as a responsible and contributing citizen and employee**
	T	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E	**CRP4. Communicate clearly and effectively with reason**
	T	**CRP5. Consider the environmental, social and economic impacts of decisions**
	E	**CRP6. Demonstrate creativity and innovation**
		CRP7. Employ valid and reliable research strategies
	E	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
	E	**CRP10. Plan education and career paths aligned to personal goals**
	E	**CRP11. Use technology to enhance productivity**
		CRP12. Work productively in teams while using cultural global competence

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills		
	X	**Global Awareness**		E	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**		E	**Creativity and Innovation**
	X	**Health Literacy**		E	**Collaboration, Teamwork and Leadership**
	X	**Civic Literacy**			**Cross-Cultural and Interpersonal Communication**
	X	**Financial, Economic, Business and**		E	**Communication and Media Fluency**
	X	**Entrepreneurial Literacy**		E	**Accountability, Productivity and Ethics**

Unit 6- Ecology

Instructional Days: 25

Unit Summary
Students analyze and interpret data, develop models, construct arguments and demonstrate a deeper understanding of the cycling of matter, the flow of energy and resources in ecosystems. They are able to study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on populations. They also understand that the limits of resources influence the growth of organisms and populations, which may result in competition for those limited resources. The crosscutting concepts of matter and energy, systems and system models, patterns and cause and effect provide a framework for understanding the disciplinary core ideas. Students demonstrate grade-appropriate proficiency in analyzing and interpreting data, developing models and constructing arguments. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS-LS2-3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
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 Sequence and Pacing: Unit 6- Ecology		
Concepts	Assessments (Formative and Summative)	Related Activities, Readings, and Resources
Topic A: Living Things & the Environment ● Organisms and populations of organisms are dependent on their environmental interactions with other living things. ● Organisms and populations of organisms are dependent on their environmental interactions with nonliving factors. ● The patterns of interactions of organisms with their environment, both its living and nonliving components, are shared. ● Interactions within ecosystems have	Students who understand concepts will be able to: ● Identify the biotic and abiotic factors in an ecosystem. ● Evaluate the basic needs and resources provided by an organism's habitat. ● Describe the levels of organization within an ecosystem. Evidence of Student Learning: Common	Abiotic/Biotic Factor Sort Ecosystem Factors Labeling Activity Nature Walk

patterns that can be used to identify cause-and-effect relationships. ● Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems.	assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic B: Populations ● In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with other limited resources. ● Access to food, water, oxygen, or other resources constrain organisms' growth and reproduction.	Students who understand concepts will be able to: ● Explain how ecologists determine the size of a population. ● Identify factors that limit population growth. ● Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Counting Turtles Lab Migration Reading/Activity Population Density Quick Lab
Topic C: Energy Flow in Ecosystems ● Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules to support growth or to release energy.	Students who understand concepts will be able to: ● Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. ● Name and describe energy roles that organisms play in an ecosystem. Evidence of Student Learning: Common	Build a Food Web Jungle Book Ecology Activity

● Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem. ● Transfers of matter into and out of the physical environment occur at every level. ● Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments. ● The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts. ● Photosynthesis has a role in the cycling of matter and flow of energy into and out of organisms. ● The flow of energy and cycling of matter can be traced.	assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic D: Interactions Among Living Things ● Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. ● Mutually beneficial interactions may become so interdependent that each organism requires the other to survive. ● Patterns of interactions among organisms across multiple ecosystems can be predicted.	Students who understand concepts will be able to: ● Provide and explain examples of the three types of symbiosis. ● Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and	Symbiosis Stations Symbiosis Color by Number

	laboratory investigations.	

Sample of Open Education Resources

- Interactive Interdependence (http://www.nsta.org/publications/news/story.aspx?id=53165)
- Flow of Matter and Energy in Ecosystems (http://ngss.nsta.org/Resource.aspx?ResourceID=173)
- Investigating Photosynthesis (http://ngss.nsta.org/Resource.aspx?ResourceID=170)
- Exploring the "systems" in Ecoystems (http://ngss.nsta.org/Resource.aspx?ResourceID=172)
- The Simple Story of Photosynthesis and Food (http://ngss.nsta.org/Resource.aspx?ResourceID=174)
- Habitable Planet Population Simulator (http://www.learner.org/courses/envsci/interactives/ecology/)
- Food Webs Lab (http://www.nsta.org/publications/press/extras/adi-lifescience.aspx)
- Chesapeake Bay Food Web (http://www.amnh.org/explore/curriculum-collections/ecology-disrupted/chesapeake-bay)

List of textbooks but not limited to:

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Modifications and Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g.

multiple representation and multimodal experiences).

- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments

increments			
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP-2: Developing and Using Models ☐ Develop a model to describe phenomena. **(MS-LS2-3)** ☐ Develop a model to describe unobservable mechanisms. (MS-LS1-7) **SEP-4: Analyzing and Interpreting Data** ☐ Analyze and interpret data to provide evidence for phenomena. **(MS-LS2-1)** **SEP-6: Constructing Explanations and Designing Solutions** ☐ 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	**PS3.D: Energy in Chemical Processes and Everyday Life** The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)* **LS1.C: Organization for Matter and Energy Flow in Organisms** Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) **LS2.A: Interdependent Relationships in Ecosystems**	**CCC-2: Cause and Effect** ☐ Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) **CCC-5: Energy and Matter** ☐ Matter is conserved because atoms are conserved in physical and chemical processes.(MS-LS1-7) ☐ Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6) ☐ The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) **CCC-1: Patterns** ☐ Patterns can be used to identify cause-and-effect relationships. (MS-LS2-2)

future. **(MS-LS1-6)** - Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) **SEP-7: Engaging in Argument from Evidence** - 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. **(MS-LS2-4)** **Connections to Nature of Science** - Science knowledge is based upon logical connections between evidence and explanations. **(MS-LS1-6)** - Science disciplines share common rules of obtaining and evaluating empirical evidence.(MS-LS2-4)	Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) **LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)	**CCC-7: Stability and Change** - Small changes in one part of a system might cause large changes in another part. (MS-LS2-4)

Technology Standard(s)
8.1.8.A.3- Use and/or develop a simulation that provides an environment to solve a real world problem or theory **8.2.8.C.1-** Explain how different teams/groups can contribute to the overall design of a product. **8.2.8.C.2-** Explain the need for optimization in a design process **8.2.8.C.5-** Explain the interdependence of a subsystem the operates as part of a system

Interdisciplinary Standard(s)

ELA/Literacy

- **RI.8.8** - 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. (MS-LS2-4)
- **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-6), (MS-LS2-1), (MS-LS2-4)
- **RST.6-8.2** - Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6)
- **RST.6-8.7** - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)
- **SL.8.5** - Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-7), (MS-LS2-3)
- **WHST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4)
- **WHST.6-8.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS1-6)
- **WHST.6-8.9** - Draw evidence from informational texts to support analysis reflection, and research. (MS-LS1-6)

Mathematics

- **6.EE.C.9** - Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6), (MS-LS2-3)

In this unit plan, the following Career Ready Practices are addressed:		
*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*		
	E,T,A	**CRP1. Act as a responsible and contributing citizen and employee**
	E,T,A	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E,T,A	**CRP4. Communicate clearly and effectively with reason**
	E,T,A	**CRP5. Consider the environmental, social and economic impacts of decisions**
		CRP6. Demonstrate creativity and innovation
		CRP7. Employ valid and reliable research strategies
	E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	E,T,A	**CRP9. Model integrity, ethical leadership and effective management**
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills		
		Global Awareness		**E,T,A**	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**			**Creativity and Innovation**
		Health Literacy		**E,T,A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E,T,A**	**Communication and Media Fluency**
		Entrepreneurial Literacy			**Accountability, Productivity and Ethics**

Unit 7- Biodiversity and Humans

Instructional Days:15

Unit Summary
Students build on their understandings of the transfer of matter and energy as they study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They construct explanations for the interactions in ecosystems and the scientific, economic, political and social justifications used in making decisions about maintaining biodiversity in ecosystems. The crosscutting concept of stability and change provide a framework for understanding the disciplinary core ideas. This unit includes a two-stage engineering design process. Students first evaluate different engineering ideas that have been proposed using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising. They then test different solutions, and combine the best ideas into a new solution that may be better than any of the preliminary ideas. Students demonstrate grade appropriate proficiency in asking questions, designing solutions, engaging in argument from evidence, developing and using models, and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives	
MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
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-ETS1-3	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 Sequence and Pacing: Unit 7- Biodiversity and Humans		
Concepts	**Assessments (Formative and Summative)**	**Related Activities, Readings, and Resources**
Topic A: Biodiversity ● Ecosystems are dynamic in nature. ● The characteristics of ecosystems can vary over time. ● Small changes in one part of an ecosystem might cause large changes in another part. ● Patterns in data about ecosystems can be recognized and used to make warranted inferences about changes in populations. ● Evaluating empirical evidence can be used to support arguments about changes to ecosystems. ● Biodiversity describes the variety of species found in Earth's terrestrial and oceanic systems. ● The completeness, or integrity, of an ecosystem's biodiversity is often used as a measure of its health.	Students who understand concepts will be able to: ● Explain the value of biodiversity. ● Identify the factors that affect biodiversity. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Biodiversity in my School Activity Balancing Ecosystems Jenga Bill Nye Biodiversity
Topic B: Human Effect ● Changes in biodiversity can influence humans' resources, such as food, energy and ● medicine. ● Changes in biodiversity can influence ecosystem services that humans rely on. ● Disruptions to any physical or biological component of an ecosystem can lead to shifts	Students who understand concepts will be able to: ● Classify natural resources. ● Provide ways that human activity both threatens and protects biodiversity. ● Collect and observe air pollution samples. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student	The Twins Reading Renewable vs. Non-renewable flippable Sustainability Activity

in all the ecosystem's populations.	conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	
Topic C: Environmental Protection ● Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. ● 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. ● A solution needs to be tested and modified on the basis of the test results, in order to improve it. ● Models of all kinds are important for testing solutions. ● There are systematic processes for evaluation solutions with respect to how well they meet the criteria and constraints of a problem.	Students who understand concepts will be able to: ● Consider and defend laws that have been passed to help protect the environment. ● Describe the efforts that are being made to conserve natural resources. ● Evaluate materials and processes used to clean up oil spills. Evidence of Student Learning: Common assessments, evaluation rubrics, teacher-student conferences, students' published work, unit tests and section quizzes, design challenges, and laboratory investigations.	Water Pollution Solutions Reading Water Pollution Gizmo Clean up on Aisle 6 Lab

Sample of Open Education Resources
● Exploring the Environment (http://ete.cet.edu/modules/modules.html) ● Exploring the "Systems" in Ecosystems (http://www.pbslearningmedia.org/resource/lsps07.sci.life.eco.lpexpecosystems/exploring-the- systems-in-ecosystems/) ● National Wildlife Federation (http://www.nwf.org/Kids.aspx) ● Conserve Wildlife Foundation of New Jersey (http://www.conservewildlifenj.org/species/threats/) ● National Invasive Species Information Center (NISIC) (http://www.invasivespeciesinfo.gov)

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Discovery Science

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- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.
- Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA)

Special Education/504 plan	ELL	RTI/Students at Risk of Failure	Accelerated Students
● Modifications and accommodations as listed in the student's IEP/504 plan ● Assign a peer to help keep student on task ● Modified reduced assignments ● Reduce length of assignment for different mode of delivery ● Increase one to one time ● Prioritize tasks ● Think in Concrete terms and provide hands on tasks ● Position student near helping peer or have quick access to teacher ● Anticipate where needs will be ● Break down into smaller increments	● Strategy groups ● Teacher conferences ● Graphic organizers ● Modification Plan ● NJDOE resources	● Tiered interventions following RTI framework ● RTI Intervention Bank ● NJDOE resources	● Contents should be modified: abstraction, complexity, variety, organization ● Open-ended responses ● Curriculum Compacting Advanced problems to extend the critical thinking skills of advanced learner ● Supplemental reading material for independent study ● Flexible grouping ● Tiered assignments
(Note: Differentiation Strategies in Discovery Education TechBook's Model Lesson for sample modifications for struggling students, English language learners, and accelerated students.)			

Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross-Cutting Concepts**
SEP- 7: Engaging in Argument from Evidence Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Ecosystems are dynamic in nature; their characteristics can vary over time.	**CCC-7: Stability and Change** Small changes in one part of a system might cause large changes in another part. (MS-LS2-5)

or a model for a phenomenon or a solution to a problem. (MS-LS2-4) Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5) **Connections to Nature of Science** Science disciplines share common rules of obtaining and evaluating empirical evidence.(MS-LS2-4)	Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) **LS4.D: Biodiversity and Humans** Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on— for example, water purification and recycling. *(secondary to MS-LS2-5)* **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.(MS-ESS3-3) **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary to MS-LS2-5)*	**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. (MS-LS2-5) **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. (MS- LS2-5)

Technology Standard(s)

8.2.8.C.1- Explain how different teams/groups can contributed to the overall design of a product

8.2.8.C.2- Explain the need for optimization in a design process

8.2.8.C.3- Evaluate the function, value and aesthetics of a technological product or system, from the perspective of the user and the producer

8.2.8.C.4- Identify the steps in the design process that would be used to solve a designated problem

8.2.8.C.5- Explain the interdependence of a subsystem that operates as part of a system

8.2.8.C.8- Develop a proposal for a chosen solution that include models (physical, graphical or mathematical) to communicate the solution to peers.

Interdisciplinary Standard(s)

ELA/Literacy

- **RI.8.8** - 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. (MS-LS2-5)
- **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-2)
- **RST.6-8.8** - Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
- **SL.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. (MS-LS2-2)
- **SL.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. (MS-LS2-2)
- **WHST.6-8.2** - Write informative/explanatory texts, including the narration of

Mathematics

- **6.RP.A.3** - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-LS2-5)
- **6.SP.B.5** - Summarize numerical data sets in relation to their context. (MS-LS2-2)

historical events, scientific procedures/ experiments, or technical processes. (MS-LS2-2) • **WHST.6-8.9** - Draw evidence from informational texts to support analysis reflection, and research. (MS-LS2-2)	

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

E,T,A	**CRP1. Act as a responsible and contributing citizen and employee**
E,T,A	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E,T,A	**CRP4. Communicate clearly and effectively with reason**
E,T,A	**CRP5. Consider the environmental, social and economic impacts of decisions**
E,T,A	**CRP6. Demonstrate creativity and innovation**
E,T	**CRP7. Employ valid and reliable research strategies**
E,T,A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
E,T,A	**CRP9. Model integrity, ethical leadership and effective management**
	CRP10. Plan education and career paths aligned to personal goals

	E,T,A	**CRP11. Use technology to enhance productivity**
	E,T,A	**CRP12. Work productively in teams while using cultural global competence**

21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**		
	x	**Global Awareness**		**E,T,A**	**Critical Thinking & Problem Solving**
	x	**Environmental Literacy**		**E,T,A**	**Creativity and Innovation**
		Health Literacy		**E,T, A**	**Collaboration, Teamwork and Leadership**
		Civic Literacy		**E,T,A**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and		**E,T,A**	**Communication and Media Fluency**
		Entrepreneurial Literacy		**E,T,A**	**Accountability, Productivity and Ethics**

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Earth and Space Sciences				
MS-ESS1 Earth's Place in the Universe				
MS-ESS1-1	Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.	X		
MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	X		
MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.	X		
MS-ESS1-4	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.	X		
MS-ESS2 Earth's Systems				
MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	X		
MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	X		
MS-ESS2-3	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.	X		
MS-ESS2-4	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	X		
MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	X		
MS-ESS2-6	Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.	X		

MS-ESS3 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.	X		
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.	X		
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	X		
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.	X		
MS-ESS3-5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	X		

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Life Science				
MS-LS1 From Molecules to Organisms: Structures and Processes				
MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.			X
MS-LS1-2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.			X
MS-LS1-3	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.			X
MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.			X
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.			X

MS-LS1-6	**Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.**			**X**
MS-LS1-7	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as the matter moves through organism.**			**X**
MS-LS1-8	**Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.**			**X**
MS-LS2 Ecosystems: Interactions, Energy, and Dynamics				
MS-LS2-1	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.**			**X**
MS-LS2-2	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.**			**X**
MS-LS2-3	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.**			**X**
MS-LS2-4	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.**			**X**
MS-LS2-5	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services.**			**X**
MS-LS3 Heredity: Inheritance and Variation of Traits				
MS-LS3-1	**Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.**			**X**
MS-LS3-2	**Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.**			**X**

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Life Science				
MS-LS4 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.			X
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.			X
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.			X
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.			X
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.			X
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.			X

STANDARD	PERFORMANCE EXPECTATION	6TH GRADE	7TH GRADE	8TH GRADE
Physical Science				
MS-PS1 Matter and Its Interactions				
MS-PS1-1	Develop models to describe atomic composition of simple molecules and extended structures.		x	
MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.		x	

MS-PS1-3	**Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.**		**x**	
MS-PS1-4	**Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.**		**x**	
MS-PS1-5	**Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.**		**x**	
MS-PS1-6	**Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.**		**x**	
MS-PS2 Motion and Stability: Forces and Interactions				
MS-PS2-1	**Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**		**X**	
MS-PS2-2	**Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.**		**X**	
MS-PS2-3	**Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.**		**X**	
MS-PS2-4	**Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**		**X**	**X**
MS-PS2-5	**Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**		**X**	
MS-PS3 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.**		**X**	
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.**		**X**	
MS-PS3-3	**Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer**		**X**	
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**		**X**	

	measured by the temperature of the sample.			
MS-PS3-5	**Construct, use, and present arguments to support the claim that when the kinetic energy of an**		**X**	

	object changes, energy is transferred to or from the object.			
STANDARD	**PERFORMANCE EXPECTATION**	6TH GRADE	7TH GRADE	8TH GRADE
Physical Science				
MS-PS4 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.**		**X**	
MS-PS4-2	**Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.**		**X**	
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.**		**X**	

STANDARD	**PERFORMANCE EXPECTATION**	**6TH GRADE**	**7TH GRADE**	**8TH GRADE**
Engineering Design				
MS – ETS1 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.**	**X**	**X**	**X**
MS-ETS1-2	**Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**		**X**	**X**

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.**	**X**	**X**	**X**
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.**		**X**	