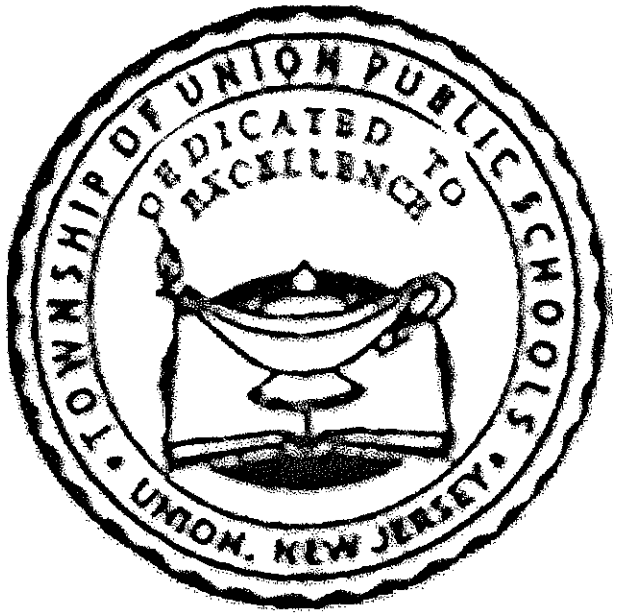
TOWNSHIP OF UNION PUBLIC SCHOOLS



6th Grade Science

Curriculum Guide

2016

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Science

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Mission Statement

The mission of the Township of Union Public Schools is to build on the foundations of honesty, excellence, integrity, strong family, and community partnerships. We promote a supportive learning environment where every student is challenged, inspired, empowered, and respected as diverse learners. Through cultivation of students' intellectual curiosity, skills and knowledge, our students can achieve academically and socially, and contribute as responsible and productive citizens of our global community.

Philosophy Statement

The Township of Union Public School District, as a societal agency, reflects democratic ideals and concepts through its educational practices. It is the belief of the Board of Education that a primary function of the Township of Union Public School System is the formulation of a learning climate conducive to the needs of all students in general, providing therein for individual differences. The school operates as a partner with the home and community.

Science Department Mission

The goal of the Union Township Science Department is to expose students to the different branches of science through the use of labs, modern technology, and field experiences. We aspire to develop scientific literacy in all students, allowing them to utilize problem solving and critical thinking skills. Students are encouraged to untap their potential by engaging in inquiry-based activities and experiments. When students develop a deep understanding of science they can truly appreciate the world in which they live.

Science Department Vision

We aspire to encourage creativity and imagination, as it allows students to explore the world around them on their own. Our classrooms are conducive to student learning and our activities are student centered. At Union Township we expect highly of our staff and students and uphold them to high standards. We would like to see students pursue science in college, their career choice, or personal interests.

Statement of District Goals

- Develop reading, writing, speaking, listening, and mathematical skills.
- Develop a pride in work and a feeling of self-worth, self-reliance, and self discipline.
- Acquire and use the skills and habits involved in critical and constructive thinking.
- Develop a code of behavior based on moral and ethical principals.
- Work with others cooperatively.
- Acquire a knowledge and appreciation of the historical record of human achievement and failures and current societal issues.
- Acquire a knowledge and understanding of the physical and biological sciences.
- Participate effectively and efficiently in economic life and the development of skills to enter a specific field of work.
- Appreciate and understand literature, art, music, and other cultural activities.
- Develop an understanding of the historical and cultural heritage.
- Develop a concern for the proper use and/or preservation of natural resources.
- Develop basic skills in sports and other forms of recreation.

Course Description

The sixth grade elaborates upon and deepens the concepts of the spiral of physical, life and earth science. This "spiral of knowledge" engenders the continuity of connections between and among the sciences aforementioned.

During the physical science unit students will learn about types of interactions and forces and motions.

During the life science unit students will learn about growth, development and reproduction. The students will also learn about the flow of matter and energy in an ecosystem as well as the interdependent relationships that take place in an ecosystem.

During the earth science unit students will learn about astronomy, weather and climate.

The sixth grade science curriculum is a link in the chain of knowledge that will allow our students to be empowered, life time learners.

Course Proficiencies- Sixth Grade Science

Unit 1: Growth, Development, and Reproduction of Organisms

- 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. MS-LS1-4
- Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS1-5

Unit 2: Matter and Energy in Organisms and Ecosystems

- Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-1
- Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS-LS2-2
- Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS-LS2-3

Unit 3: Interdependent Relationships in Ecosystems

- Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations . MS-LS2-4
- Evaluate competing design solutions for maintaining biodiversity and ecosystem services. MS-LS2-5
- 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-ETS1-1
- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3

Unit 4: Forces and Motion

- Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects . MS-PS2-1
- Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. MS-PS2-2
- 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-ETS1-1
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-2
- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3.
- Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. MS-ETS1-4

Unit 5: Types of Interactions

- Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. MS-PS2-3
- Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS2-4
- Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS-PS2-5

Unit 6: Astronomy

- 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-ESS1-1
- Generate and analyze evidence (through simulations or long term investigations) to explain why the Sun's apparent motion across the sky changes over the course of a year. MS-ESS1-1
- Develop and use a model that shows how gravity causes smaller objects to orbit around larger objects at increasing scales, including the gravitational force of the sun causes the planets and other bodies to orbit around it holding together the solar system together. ESS1.A; ESS1.B
- Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS-ESS1-2
- Analyze and interpret data to determine scale properties of objects in the solar system. MS-ESS1-3

Unit 7: Weather and Climate

- Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. MS-ESS2-4
- Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. MS-ESS2-5
- Explain how variations in density result from variations in temperature and salinity drive a global pattern of interconnected ocean currents ESS2.C
- Use a model to explain the mechanisms that cause varying daily temperature ranges in a coastal community and in a community located in the interior of the country. ESS2.C; ESS2.DDevelop 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-ESS2-6

Curriculum Units – Sixth Grade Science

- **Unit 1**: Growth, Development, and Reproduction of Organisms
- **Unit 2**: Matter and Energy in Organisms and Ecosystems
- **Unit 3**: Interdependent Relationships in Ecosystems
- **Unit 4**: Forces and Motion
- **Unit 5**: Types of Interactions
- **Unit 6**: Astronomy
- **Unit 7**: Weather and Climate

Pacing Guide- Sixth Grade Science

Unit 1: Growth, Development, and Reproduction of Organisms **Instructional Days: 25**

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.

This unit is based on MS-LS1-4 and MS-LS1-5.

Instructional Days: 25

Unit 2: Matter and Energy in Organisms and Ecosystems

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 interpret data, developing models, and constructing arguments. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-LS2-1, MS-LS2-2, and MS-LS2-3.

Unit 3: Interdependent Relationships in Ecosystems

Instructional Days: 25

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 a 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.

This unit is based on MS-LS2-4, MS-LS2-5, MS-ETS1-1, and MS-ETS1-3.

Instructional Days: 25

Unit 4: Forces and Motion

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

This unit is based on MS-PS2-1, MS-PS2-2, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, and MS-ETS1-4.

Unit 5: Types of Interactions **Instructional Days: 25**

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

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

Instructional Days: 20

Unit 6: Astronomy

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.

This unit is based on MS-ESS1-1, MS-ESS1-2, and MS-ESS1-3.

Unit 7: Weather and Climate

Instructional Days: 20

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 and climate. 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 though 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.

This unit is based on MS-ESS2-4, MS-ESS2-5, and MS-ESS2-6.

Unit 1: Growth, Development, and Reproduction of Organisms

Unit Summary

What influences the growth and development of an organism?

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.

This unit is based on MS-LS1-4 and MS-LS1-5.

Student Learning Objectives

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. *[Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]* **(MS-LS1-4)**

Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. *[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]* **(MS-LS1-5)**

Unit Sequence	
Part A: *How do characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively?*	
Concepts	**Formative Assessment**
• Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. ✓ There are a variety of ways that plants reproduce. • Specialized structures for plants affect their probability of successful reproduction. • Some characteristic animal behaviors affect the probability of successful reproduction in plants. • 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. • 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 the concepts are able to:* • Collect empirical evidence about animal behaviors that affect the animals' probability of successful reproduction and also affect the probability of plant reproduction. • Collect empirical evidence about plant structures that are specialized for reproductive success. • Use empirical evidence from experiments and other scientific reasoning to support oral and written arguments that explain the relationship among plant structure, animal behavior, and the reproductive success of plants. • Identify and describe possible cause-and effect relationships affecting the reproductive success of plants and animals using probability. • Support or refute an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful plant reproduction using oral and written arguments.

Unit Sequence	
Part B: *How do environmental and genetic factors influence the growth of organisms?*	
Concepts	**Formative Assessment**
• Genetic factors as well as local conditions affect the growth of organisms. ✓ A variety of local environmental conditions affect the growth of organisms. • Genetic factors affect the growth of organisms (plant and animal).	*Students who understand the concepts are able to:* • Conduct experiments, collect evidence, and analyze empirical data. • Use evidence from experiments and other scientific reasoning to support oral and written explanations of how environmental and genetic factors influence the growth of organisms.

• 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.	• Identify and describe possible causes and effects of local environmental conditions on the growth of organisms. • Identify and describe possible causes and effects of genetic conditions on the growth of organisms.

Three-Dimensional Teaching and Learning

Instruction should result in students being able to use arguments based on empirical evidence and scientific reasoning to support an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants. Students may observe examples of plant structures that could affect the probability of plant reproduction, including bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract pollen-transferring insects, and hard shells on nuts that squirrels bury. Possible activities could include plant experiments (e.g., students could count the number of butterflies on brightly colored plants vs. the number of butterflies on other types of plants and record the data they collect in a table), using microscopes/magnifiers to view plant structures (e.g., dissecting a lily), going on field trips, both virtual and actual (e.g., butterfly garden/botanical garden).

Students may observe examples of animal behaviors that affect the probability of plant reproduction, which could include observing how animals can transfer pollen or seeds and how animals can create conditions for seed germination and growth (e.g., students may conduct an experiment using rapid cycling Brassica rapa [Fast Plant] and collect data on how many plants produce seeds with and without the aid of a pollinator.

Students could then observe examples of animal behaviors (using videos, Internet resources, books, etc.) that could affect the probability of successful animal reproduction. These behaviors could include nest building to protect young from cold, herding of animals to protect young from predators, and colorful plumage and vocalizations to attract mates for breeding. Students may be able to identify and describe possible cause-and-effect relationships in factors that contribute to the reproductive success of plants and animals by using probability data from the rapid-cycling *Brassica rapa* (Fast Plant) experiments and drawing conclusions about one relationship between animals and plants.

At this point, students can present an oral and/or written argument supported by evidence and scientific reasoning that characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. Students may use evidence from experiments or other sources to identify the role of pollinators in plant reproduction.

Instruction that results in students being able to construct an evidence-based scientific explanation for how environmental and genetic factors influence the growth of organisms could begin with students conducting experiments and collecting data on the environmental conditions that effect the growth of organisms (e.g., the effect of variables such as food, light, space, and water on plant growth).

Students could then examine genetic factors (inherited traits) that influence the growth of organisms, including parental traits and selective breeding. *It is important to note that at this grade level, Mendelian genetics are not a part of student learning. Mendelian genetics will be covered in future grades.* This unit of study could end with students using an oral and/or written argument, supported by evidence and scientific reasoning from their

experiments, to explain how environmental conditions and genetic factors affect the growth of an organism.

Connections to Other Units

Grade 6 Unit 2: Matter and Energy in Organisms and Ecosystems

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

Appendix A: NGSS and Foundations for the Unit

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. *[Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]* **(MS-LS1-4)**

Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. *[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]* **(MS-LS1-5)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Use 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-LS1-4) **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	**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-LS1-5)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-4),(MS-LS1-5) • 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) **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

and will continue to do so in the future. (MS-LS1-5)		parts; therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-4), (MS-LS1-5)

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4),(MS-LS1-5) **RST.6-8.1** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5) **RST.6-8.2** 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) **RI.6.8** Write arguments focused on discipline content. (MS-LS1-4) **WHST.6-8.1** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5) **WHST.6-8.2** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5) **WHST.6-8.9**	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.A.2** Summarize numerical data sets in relation to their context. (MS-LS1-4),(MS-LS1-5) **6.SP.B.4**

Unit 1: Growth, Development and Reproduction of Organisms (25 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
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.	1. Vegetative Propagation 2. Animal Behavior Activity 3. Pollen Observations Lab 4. Flower Dissection Lab	1. Attachment 2. Attachment 3. Attachment 4. Attachment https://njctl.org/courses/science/7th-grade-science/growth-and-development-of-organisms/
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms		

1. By completing this activity students learn about vegetative reproduction. Students grow new individual plants from a root, stem, or leaf. This helps students understand the different ways in which plants grow and why it is important to have more than one way.

2. Students watch a brief video clip about sea turtles and it helps students understand the various precautions sea turtles take to ensure the safety for their eggs. Students also identify factors which could affect the sea turtle; for example, tourism.

3. This lab illustrates to students how plants get pollen to their ovules. The students complete various drawings and then compare them. Students apply this lab to real life and explain how pollen could be used to identify the type of plant and how pollen from specific plants may trigger seasonal allergies for some individuals.

4. In this lab students dissect a flower to learn about the parts of the plants and they identify what is necessary for successful reproduction; for example, the color of the flower needs to be bright that attracts pollinators such as bees. The petals are very wide allowing pollinators to get to the pollen.

Unit 2: Matter and Energy in Organisms and Ecosystems

Unit Summary

How and why do organisms interact with their environment and what are the effects of these interactions?

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 interpret data, developing models, and constructing arguments. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-LS2-1, MS-LS2-2, and MS-LS2-3.

Student Learning Objectives

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. *[Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]* **(MS-LS2-1)**

Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. *[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]* **(MS-LS2-2)**

Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. *[Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]* **(MS-LS2-3)**

Unit Sequence	
Part A: *How do changes in the availability of matter and energy effect populations in an ecosystem?*	
Concepts	**Formative Assessment**
• 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. • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources. • Access to food, water, oxygen, or other resources constrain organisms' growth and reproduction.	*Students who understand the concepts are able to:* • Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. • Use cause-and-effect relationships to predict the effect of resource availability on organisms and populations in natural systems.

Unit Sequence	
Part B: *How do relationships among organisms, in an ecosystem, effect populations?*	
Concepts	**Formative Assessment**
• 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 for survival. • The patterns of interactions of organisms with their environment, both its living and nonliving components, are shared. • Interactions within ecosystems have patterns that can be used to identify cause-and-effect relationships. • Patterns of interactions among organisms across multiple ecosystems can be predicted. • Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems.	*Students who understand the concepts are able to:* • Construct an explanation about interactions within ecosystems. • Include qualitative or quantitative relationships between variables as part of explanations about interactions within ecosystems. • Make predictions about the impact within and across ecosystems of competitive, predatory, or mutually beneficial relationships as abiotic (e.g., floods, habitat loss) or biotic (e.g., predation) components change.

Unit Sequence	
Part C: How can you explain the stability of an ecosystem by tracing the flow of matter and energy?	
Concepts	**Formative Assessment**
• 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. • Decomposers recycle nutrients from dead plant or animal matter back 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. • The transfer of energy can be tracked as energy flows through an ecosystem. • Science assumes that objects and events in ecosystems occur in consistent patterns that are understandable through measurement and observation.	• *Students who understand the concepts are able to:* • Develop a model to describe the cycling of matter among living and nonliving parts of an ecosystem. • Develop a model to describe the flow of energy among living and nonliving parts of ecosystem. Track the transfer of energy as energy flows through an ecosystem. • Observe and measure patterns of objects and events in ecosystems.

Connections to Other Units

Grade 6 Unit 3: Interdependent Relationships in Ecosystems

- 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.

Grade 7 Unit 1: Structure and Properties of Matter

- Substances react chemically in characteristic ways.

Grade 7 Unit 3: Chemical Reactions

- In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Grade 7 Unit 8: Earth 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.
- 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 its future.

Grade 8 Unit 3: Stability and Change on Earth

- 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.
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

Appendix A: NGSS and Foundations for the Unit

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. *[Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]* **(MS-LS2-1)**

Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. *[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]* **(MS-LS2-2)**

Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. *[Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]* **(MS-LS2-3)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data • Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1) **Constructing Explanations and Designing Solutions** • Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) **Developing and Using Models** • Develop a model to describe phenomena. (MS-LS2-3)	**LS2.A: Interdependent Relationships in Ecosystems** • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) • Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually	**Patterns** • Patterns can be used to identify cause and effect relationships. (MS-LS2-2) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) **Energy and Matter** • The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) --- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

	beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) **LS2.B: Cycle 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)	• Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

English Language Arts	**Mathematics**
Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2) **RST.6-8.1** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1) **RST.6-8.7** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and	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-LS2-3) **6.EE.C.9** Summarize numerical data sets in relation to their context. (MS-LS2-2)

analysis of relevant content. (MS-LS2-2) **WHST.6-8.2** Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2) **WHST.6-8.9** 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.8.1** 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) **SL.8.4** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS2-3) **SL.8.5**	**6.SP.B.5**

Unit 2: Matter and Energy in Organisms and Ecosystems (25 days)			
This unit is based on:	SLO	STEM	Quick Links
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.	1. Cells to tissues to organs 2. Ecosystem match up 3. The feeling is mutual	1. http://betterlesson.com/lesson/632404/cells-to-tissues-to-organs 2. http://betterlesson.com/lesson/631890/ecosystem-match-up 3. http://betterlesson.com/lesson/631889/the-feeling-is-mutual
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	4. Going-Going-Gone 5. Food Chains & Food Webs: Problem Solving	4. http://betterlesson.com/lesson/631896/going-going-gone-5-day-project-based-lesson 5. http://betterlesson.com/lesson/631767/food-chains-food-webs-problem-solving
MS-LS2-3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem	6. Biotic and Abiotic Factors 7. Energy Flow in Ecosystems	6. http://betterlesson.com/lesson/639248/biotic-and-abiotic-factors 7. http://betterlesson.com/lesson/639253/energy-flow-in-ecosystems

1. Cells to Tissues to Organs – The start of this website contains a great unit starter where teachers will determine if students recognize that the human body is an organized collection of cells given several scenarios and students have to choose the correct scenario and explain why.
2. Ecosystem Match Up - Start the lesson by writing the word "ecosystem" on the board and have students write down everything they know about the term – they can write things they are sure of and things they think they know (it's ok if it is wrong right now) – after the time is up students will hand in this paper and NOT discuss yet in order not to share inaccurate information. They will come back to it at the end of the lesson. Students will then be placed in groups where they will research one of the ecosystems. In order to complete the research they must fold a piece of paper into thirds. They will have 6 sections (3 on the front and 3 on the back). Each section will have the title: location, climate, plant life, ground covering, common landforms, animal life/adaptations. Each student within their group will share their findings and identify information that is common throughout and follow up with further research to verify conflicting views. Once research is completed each group will collaborate to create a poster presentation – the only thing not included is the animal life found there. Next the students will be regrouped with an expert placed in each group and the posters will be hung and students will complete a gallery walk taking important notes on each ecosystem. When the gallery walk is complete each group will be given animal cards with description and once they figure out their ecosystem they will place the card on that poster. In order to assess and evaluate you can return to the original paper regarding the word "ecosystem" so students can confirm or fix any mistakes.

3. The Feeling is Mutual – In this activity students will be able to differentiate between symbiotic relationships among animals in an ecosystem inlcudin symbiosis, commensalism, mutualism, parasitism, competition and predatory relationships. Start by watching "does my dog have fleas" video and ask, "what you watched was a very natural interaction between two different organisms. Who benefited from the interaction? The fleas, the dog, or both? Next, students will receive the "Animal Relationships" worksheet and while watching Symbiosis: Mutualism, Commensalism and Parasitism students will complete the worksheet. After watching the video and filling in the blanks with the correct response students should be asked to sketch a drawing that will serve as a symbol of each relationship (example: mutualism can be represented with the links of a chain). Students will then be paired up and read through the 30 examples of symbiotic relationships and determine which type is represented by each scenario. Students should be able to utilize resources in order to do this. Review the student answers and finish with the Good Buddy Game. (found in the attachments) .
4. Going-Going-Gone – Students will start this lesson by observing the following words: Least Concern/Safe, Near Threatened , Vulnerable/Threatened , Endangered , Critically Endangered , Extinct in the Wild , Extinct (after watching a video clip students will organize these words from most problematic to least problematic). Students will then take the "which species are you" quiz in order to find a species to complete their project on. Students will complete research on their animal in order to create a Public Service Announcement (useful websites are in the resources). The grading checklist for their Public Service Announcement is attached – presentations will be conducted.
5. Food Chains & Food Webs: Problem Solving – (Also goes with MS-LS2-3) Students will create their own food chains, food webs and food pyramids for an ecosystem of their choice. Class Opener – Think of an Ecosystem you are interested in and try to list 5-10 plants and animals that live there. (this will have students create a bank of animals and plants for their food chains and webs. When completed students will work with a partner to see if they can add any additional information to their list. Students can view the samples (located in resources) to choose their method to present their food web.
6. Biotic and Abiotic Factors: Students will start the lesson with a video clip (in resources). After video clip is completed students will receive their intro worksheet which asks, "Organisms are part of their environment which is rich in living and non-living elements that interact with each other in some way. How do organisms interact with the living and non-living elements of their environment?" Next, show students the slideshow discussing biotic and abiotic factors – stop at slide 6. From here students are to create a T chart with the heading Abiotic and Biotic. Students will be taken outside for 10 minutes where they need to recognize and record as many biotic and abiotic factors as they can. Discuss factors recorded and return to slideshow starting at slide 7. And discuss the following questions:" If there is no water... can anything grow or survive? Why? If it is extremely cold one winter, will that effect whether an animal makes it to spring? How?" Students will then be given a Biotic and Abiotic note-catcher and each group will get a picture – students have to find at least 3 abiotic and 3 biotic factors in the picture.
7. Energy Flow in Ecosystems – Students will begin with a video clip (in resources) and after watching students will be given guided notes where they can start by writing down the big idea they learned from the video. Continue with the Energy Flow Power Point while students complete guided notes and interact with answering questions. To show student understanding have students work together to complete the Virtual Lab: Model Ecosystems (website in resources).

Unit 3: Interdependent Relationships in Ecosystems

Unit Summary

What happens to ecosystems when the environment changes?

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 a 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.

This unit is based on MS-LS2-4, MS-LS2-5, MS-ETS1-1, and MS-ETS1-3.

Student Learning Objectives

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. *[Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]* **(MS-LS2-4)**

Evaluate competing design solutions for maintaining biodiversity and ecosystem services. * *[Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]* **(MS-LS2-5)**

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-ETS1-1)

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

Unit Sequence	
***Part A:** How can a single change to an ecosystem disrupt the whole system?*	
Concepts	**Formative Assessment**
• Ecosystems are dynamic in nature. • The characteristics of ecosystems can vary over time. • Disruptions to any physical or biological component of an ecosystem can lead to shifts in all the ecosystem's populations. • 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.	*Students who understand the concepts are able to:* • Construct an argument to support or refute an explanation for the changes to populations in an ecosystem caused by disruptions to a physical or biological component of that ecosystem. Empirical evidence and scientific reasoning must support the argument. • Use scientific rules for obtaining and evaluating empirical evidence. • Recognize patterns in data and make warranted inferences about changes in populations. • Evaluate empirical evidence supporting arguments about changes to ecosystems.

Unit Sequence	
***Part B:** What limits the number and variety of living things in an ecosystem?*	
Concepts	**Formative Assessment**
• Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. • The completeness, or integrity, of an ecosystem's biodiversity is often used as a measure of its health. • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines. • Changes in biodiversity can influence ecosystem services that humans rely on. • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • A solution needs to be tested and then modified on the basis of the test results, in order to improve it.	*Students who understand the concepts are able to:* • Construct a convincing argument that supports or refutes claims for solutions about the natural and designed world(s). • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. • Create design criteria for design solutions for maintaining biodiversity and ecosystem services. • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.

• Models of all kinds are important for testing solutions. • 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. • Small changes in one part of a system might cause large changes in another part. • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.	

Connections to Other Units

Grade 6 Unit 3: Interdependent Relationships in Ecosystems

- 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.

Grade 7 Unit 1: Structure and Properties of Matter

- Substances react chemically in characteristic ways.

Grade 7 Unit 3: Chemical Reactions

- In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Grade 7 Unit 8: Earth 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.
- 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 its future.

Grade 8 Unit 3: Stability and Change on Earth

- 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.

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

Appendix A: NGSS and Foundations for the Unit
Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. *[Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]* **(MS-LS2-4)**
Evaluate competing design solutions for maintaining biodiversity and ecosystem services. * *[Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]* **(MS-LS2-5)**
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-ETS1-1)
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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)	LS2.C: Ecosystem Dynamics, Functioning, and Resilience • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to	Stability and Change • Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

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. (MS-ETS1-1)

Developing and Using Models

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data

- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

shifts in all its populations. (MS-LS2-4)

- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

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)

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)*

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, in order to improve it. (MS-ETS1-4)
- There are systematic processes for

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- The use 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)

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-LS2-3)

Scientific Knowledge is Based on Empirical Evidence

- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

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)

	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)	

English Language Arts	**Mathematics**
Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4) **RST.6-8.1** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5) **RST.6-8.8** Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-5) **RI.8.8** Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4),(MS-ETS1-1),(MS-ETS1-3) **WHST.6-8.1** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and	Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-3) **MP.2** Model with mathematics. (MS-LS2-5) **MP.4** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-3) **7.EE.3** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5) **6.RP.A.3**

analysis of relevant content. (MS-LS2-2) **WHST.6-8.2** 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-ETS1-3) **RST.6-8.7** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) **WHST.6-8.8** Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2),(MS-LS2-4),(MS-ETS1-3), (MS-ETS1-2) **WHST.6-8.9** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4) **SL.8.5**	

Unit 3: Interdependent Relationships in Ecosystems (25 days)			
This unit is based on:	SLO	STEM	Quick Links
MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	1. Biodiversity DBQ 2. Sheep population graph 3. Spider Biodiversity Project	1. Attachment 2. Attachment 3. http://betterlesson.com/lesson/630437/introduction-of-spider-biodiversity-quest
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services..	4. Water purification project 5. Soil Erosion Activity 6. Saving the World – one ecosystem at a time	4. http://www.safewaterscience.org/Downloads/Lesson2.pdf 5. http://www.sciencefairadventure.com/ProjectDetail.aspx?ProjectID=182 6. http://www.nsta.org/docs/DoingGoodScienceChapter15.pdf
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.	4. Water purification project	
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.	4. Water purification project	

1. Students will read an article on how the biodiversity of the Everglades is being affected by invasive species, and then answer questions using evidence from the text to support their response.

2. Students will construct a graph to track the population of sheep on an island in Scotland. They will then use the graph to determine what caused the changes to the population, and predict how the population might change in the future.

3. Students will research spiders in their local community and their role in the ecosystem. Students will explain why maintaining biodiversity is important to the health of an ecosystem

4. Students will first discuss how various contaminants in the water supply affect an ecosystem. Then, students will design and build a device which will purify water. Students will present their devices and compare their results to the results of the other groups.

5. Students will demonstrate the devastating effects of soil erosion on various landscapes (with and without plant cover, and varying slopes) to determine how to prevent erosion.

6. Students will research and present an evidence based argument proposing various solutions to maintaining biodiversity and equilibrium in an ecosystem.

Unit 4: Forces and Motion

Unit Summary

How can we predict the motion of an object?

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

This unit is based on MS-PS2-1, MS-PS2-2, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, and MS-ETS1-4.

Student Learning Objectives

Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. * *[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]* **(MS-PS2-1)**

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

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-ETS1-1)

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that

can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

Unit Sequence	
***Part A:** How does a sailboat work?*	
Concepts	**Formative Assessment**
• 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). • Models can be used to represent the motion of objects in colliding systems and their interactions, such as inputs, processes, and outputs, as well as energy and matter flows within systems. • 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. • 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, which are likely to limit possible solutions.	*Students who understand the concepts are able to:* • Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects. • Define a design problem involving the motion of two colliding objects that can be solved through the development of an object, tool, process, or system and that includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. • Evaluate competing design solutions involving the motion of two colliding objects based on jointly developed and agreed-upon design criteria. • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. • Analyze and interpret data to determine similarities and differences in findings.

Unit Sequence	
***Part B:** Who can build the fastest sailboat?*	
Concepts	**Formative Assessment**
• The change in an object's motion depends on balanced (Newton's first law) and unbalanced forces in a system Evidence that the change in an object's motion depends on the sum of the forces on the object	*Students who understand the concepts are able to:* • Plan an investigation individually and collaboratively to provide

and the mass of the object includes qualitative comparisons of forces, mass, and changes in motion (Newton's second law); frame of reference; and specification of units • 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. • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.	evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. • Design an investigation and identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. • Make logical and conceptual connections between evidence and explanations. • Examine the changes over time and forces at different scales to explain the stability and change in designed systems.

Connections to Other Units

Grade 8 Unit 5: Relationships among Forms 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.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

Grade 8 Unit 6: Thermal 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.

Grade 6 Unit 7: Weather and Climate

- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
- 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.
- Global movements of water and its changes in form are propelled by sunlight and gravity.
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create

underground formations.

Appendix A: NGSS and Foundations for the Unit
Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. * *[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]* **(MS-PS2-1)**
Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. *[Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]* **(MS-PS2-2)**
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-ETS1-1)
Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)
Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • Plan an investigation individually and collaboratively, and in the design: identify	PS2.A: Forces and Motion • For any pair of interacting objects, the force exerted by the first object on the second	Systems and System Models • Models can be used to represent systems and their interactions—such as inputs,

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. (MS-PS2-2) **Constructing Explanations and Designing Solutions** • Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1) **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. (MS-ETS1-1) **Engaging in Argument from Evidence** • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	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: 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)	processes and outputs—and energy and matter flows within systems. (MS-PS2-1) **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. (MS-PS2-2) --- ***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. (MS-PS2-1) • All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) • The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

	• 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)	

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS2-1),(MS-ETS1-1),(MS-ETS1-2) **RST.6-8.1** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1),(MS-PS2-2) **RST.6-8.3** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each	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

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**	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**

Unit 4: Force and Motion (25 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
MS-PS2-1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.	1. Newton's Second and Third Laws of Motion: Bumper Boats Investigation 2. Newton's Laws of Motion Simulation Investigation 3. Newton's Laws Graffiti	1. http://betterlesson.com/lesson/634470/newton-s-second-and-third-laws-of-motion-bumper-boats-investigation 2. http://betterlesson.com/lesson/634620/newton-s-laws-of-motion-simulation-investigation AND https://phet.colorado.edu/en/simulation/forces-and-motion-basics 3. http://betterlesson.com/lesson/634616/newton-s-laws-graffiti
MS-PS2-2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.		
MS-ETS1-1	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.	4. Dream Invention 5. Thermal Protection Systems 6. Hot Air Balloons	4. http://betterlesson.com/lesson/617482/dream-invention 5. http://betterlesson.com/lesson/634000/thermal-protection-systems-day-1 AND http://betterlesson.com/lesson/635048/thermal-protection-systems-day-2-and-day-3?from=owner_unit 6. http://betterlesson.com/lesson/640487/hot-air-balloons
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.		
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.		
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved		

1. Newton's Second and Third Laws of Motion: Bumper Boats Investigation – Students will through inquiry discover the way Newton's laws of motion affect moving objects, students will take part in both teacher designed inquiry, and student designed inquiry

2. Newton's Laws of Motion Simulation Investigation – SWBAT understand that the motion of objects depends on the sum of the forces on the object and the mass of the object, this lesson includes the use of a PHet simulation

3. Newton's Laws Graffiti – SWBAT describe Newton's Laws of motion, SWBAT demonstrate understanding that Newton's laws help us to explain and predict the motion of objects through art

4. Dream Invention – SWBAT use the design process to dream up an original invention or innovation, and present it to the class

5. Thermal Protection Systems - SWBAT apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer

6. Hot Air Balloons – SWBAT create hot air balloons that lift off the ground, using the scientific and engineering design process.

Unit 5: Types of Interactions

Unit Summary

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

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

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

Student Learning Objectives

Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. *[Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.]* **(MS-PS2-5)**

Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. *[Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]* **(MS-PS2-3)**

Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. *[Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary:*

Assessment does not include Newton's Law of Gravitation or Kepler's Laws.] **(MS-PS2-4)**

Unit Sequence	
***Part A:** Can you apply a force on something without touching it?*	
Concepts	**Formative Assessment**
• 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.	*Students who understand the concepts are able to:* • Students will conduct an investigation and evaluate an experimental design to produce data that can serve as the basis for evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. • Students will identify the cause-and-effect relationships between fields that exist between objects and the behavior of the objects.

Unit Sequence	
***Part B:** How does a Maglev train work?*	
Concepts	**Formative Assessment**
• 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	*Students who understand the concepts are able to:* • Students will ask questions about data to determine the effect of the strength of electric and magnetic forces that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. • Students will perform investigations using devices that use electromagnetic forces. • Students will collect and analyze data that could include the effect of the number of turns of wire on the strength of an electromagnet or

designed systems	the effect of increasing the number or strength of magnets on the speed of an electric motor.

Unit Sequence	
Part C: *If I were able to eliminate air resistance and dropped a feather and a hammer at the same time, which would land first?*	
Concepts	**Formative Assessment**
• 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 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.	*Students who understand the concepts are able to:* • Students construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. • Students use models to represent the gravitational interactions between two masses.

Connections to Other Units
Grade 6 Unit 6: Astronomy • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. • 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. • The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **Grade 6 Unit 7: Weather and Climate** • Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. • Global movements of water and its changes in form are propelled by sunlight and gravity. • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. • 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. • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. **Grade 7 Unit 8: Earth Systems** • 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. •

Appendix A: NGSS and Foundations for the Unit
Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. *[Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.]* **(MS-PS2-**

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Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. *[Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]* **(MS-PS2-3)**

Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. *[Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]* **(MS-PS2-4)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking • Use mathematical representations of phenomena to describe explanations. (HS-PS2-4) **Constructing Explanations and Designing Solutions** • Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3) **Planning and Carrying Out Investigations** • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider	**PS2.B: Types of Interactions** • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4) • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4) **PS2.A: Forces and Motion** • If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4) **Cause and Effect** • Systems can be designed to cause a desired effect. (HS-PS2-3) • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-5)

limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5)	objects outside the system. (HS-PS2-3) **ETS1.A: Defining and Delimiting an Engineering Problem** • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary) (HS-PS2-3) **ETS1.C: Optimizing the Design Solution** • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary HS-PS2-3)* **PS2.B: Types of Interactions** • Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-5) • Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-5) **PS3.A: Definitions of Energy** • "Electrical energy" may mean energy stored in a battery or energy transmitted by	--- ***Connections to Nature of Science*** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Theories and laws provide explanations in science. (HS-PS2-4) • Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-4)

	electric currents. *(secondary HS-PS2-5)*	

English Language Arts	Mathematics
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.(HS-PS2-5), (HS-PS2-3) **WHST.11-12.7** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS2-5) **WHST.11-12.8** Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-5) **WHST.11-12.9**	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-5),(HS-PS2-4) **HSN.Q.A.1** Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-5),(HS-PS2-4) **HSN.Q.A.2** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-5),(HS-PS2-4) **HSN.Q.A.3** Reason abstractly and quantitatively. (HS-PS2-4) **MP.2** Model with mathematics. (HS-PS2-4) **MP.4** Interpret expressions that represent a quantity in terms of its context. (HS-PS2-4) **HSA.SSE.A.1** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-4) **HSA.SSE.B.3**

Unit 5: Types of Interactions (25 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
MS-PS2-3	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.	1. Electromagnetics 2. Circuits: A Probe for Prior Knowledge Becomes a Lesson 3. Static Electricity	1.http://betterlesson.com/lesson/637179/electromagnets 2. http://betterlesson.com/lesson/636486/circuits-a-probe-for-prior-knowledge-becomes-a-lesson 3. http://betterlesson.com/lesson/638084/static-electricity
MS-PS2-4	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces	4. Mass vs. Weight 5. Gravity: Motion on a slope	4. http://betterlesson.com/lesson/638056/mass-versus-weight-travel-to-other-planets 5. http://betterlesson.com/lesson/640498/gravity-part-3
MS-PS2-5	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.	6. Measurement: Forces 7. Using Scientific formula 8. Exploring magnetic levitation	6.http://betterlesson.com/lesson/637564/measurement-forces 7. http://betterlesson.com/lesson/638982/using-scientific-formulas 8. http://betterlesson.com/lesson/601238/exploring-magnetic-levitation

1. This lesson connects prior student knowledge of magnets to electricity. Electromagnets help prepare students to connect their understanding of the Earth's magnetosphere in Earth Science. Students will then be able to make connections to see the Earth as an electromagnet with the source of the current in the movement of the core. **This lesson is specifically designed to meet the following NGSS: MS-PS2-3.** Students make a connection between electricity and magnetism. They develop their understanding of cause and effect relationships.
2. Students will take a closer look at electric motors and electromagnets when I decided to check for student understanding of basic circuits. This lesson quickly brings students up to speed so we can explore middle school standards. **This lesson is specifically designed to meet the following NGSS: MS-PS2-3.**
3. In electrical circuits charges are moving all the time. Therefore static electricity is called static since the charges are mostly stationary. This lesson helps clarify the terminology along with supporting the standard MS-PS2-3 *Ask questions about data to determine the factors that affect the strength and direction of electric forces.*
4. By virtually visiting other planets, students use mathematical computations (**SP5**) to explore the scientific relationship between mass and gravitational acceleration (**MS-PS2-4**) by using algebraic expressions and equations (**CCC**) to calculate their weight on other planets. This lesson links physics to chemistry by exposing how forces interact with matter - and that properties of matter (like mass) have an effect on the magnitude of those forces (**MS-PS1-2**).
5. In this lesson students will understand the forces that act on an object on a slope and the acceleration that result. Understand how to represent motion on a slope in a velocity over time graph and understand where F=ma is in motion on a slope. **This lesson is specifically designed to meet the following NGSS: MS-PS2-4.**
6. This lesson is not a comprehensive exploration of forces, but rather an introduction to the concept and practice measuring forces using a spring scale. Understanding forces and how to measure them is fundamental be accessing several NGSS Disciplinary Core Ideas (DCI), especially those related to **MS-PS2 Motion and Stability: Forces and Interactions** and **MS-PS1 Matter and its Interactions**. Additionally, as students learn about measurement of forces, they access the **Crosscutting Concept** related to measurement (standard units are used to measure and describe physical quantities). Also, practice collecting data accurately to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions (**SP3**) is a scientific practice necessary for planning and carrying out investigations.
7. This lesson helps student's use mathematical reasoning to calculate the power of a wind turbine by plugging data into science formulas. This lesson is designed to meet the following NGSS: MS-PS2-5
8. This lesson uses a wide variety of strategies to help students understand how the future of transportation engineering includes some really cool science concepts. This lesson is designed to meet the following NGSS: MS-PS2-5

Unit 6: Astronomy

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.

This unit is based on MS-ESS1-1, MS-ESS1-2, and MS-ESS1-3.

Student Learning Objectives

Generate and analyze evidence (through simulations or long term investigations) to explain why the Sun's apparent motion across the sky changes over the course of a year. (ESS1.B) *[Clarification Statement: This SLO is based on a disciplinary core idea found in the Framework. It is included as a scaffold to the following SLO.]*

Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. *[Clarification Statement: Examples of models can be physical, graphical, or conceptual.]* (MS-ESS1-1)

Develop and use a model that shows how gravity causes smaller objects to orbit around larger objects at increasing scales, including the gravitational force of the sun causes the planets and other bodies to orbit around it holding together the solar system. (ESS1.A; ESS1.B) *[Clarification Statement: This SLO is based on disciplinary core ideas found in the Framework. It is included as a scaffold to the following SLO.]*

Analyze and interpret data to determine scale properties of objects in the solar system. *[Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include*

recalling facts about properties of the planets and other solar system bodies.] **(MS-ESS1-3)**
Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. *[Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]* **(MS-ESS1-2)**

Unit Sequence	
Part A: *What pattern in the Earth–sun–moon system can be used to explain lunar phases, eclipses of the sun and moon, and seasons?*	
Concepts	**Formative Assessment**
• 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. • Science assumes that objects and events in the solar system systems occur in consistent patterns that are understandable through measurement and observation.	*Students who understand the concepts are able to:* • Students will develop and use a physical, graphical, or conceptual model to describe patterns in the apparent motion of the sun, moon, and stars in the sky.

Unit Sequence	
Part B: *What is the role of gravity in the motions within galaxies and the solar system?*	
Concepts	**Formative Assessment**

• 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. • 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. • Models can be used to represent the role of gravity in the motions and interactions within galaxies and the solar system. • Science assumes that objects and events in the solar systems occur in consistent patterns that are understandable through measurement and observation.	*Students who understand the concepts are able to:* • Students develop and use models to explain the relationship between the tilt of Earth's axis and seasons.

Unit Sequence	
***Part C:** What are the scale properties of objects in the solar system?*	
Concepts	**Formative Assessment**
• 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. • • Time, space, and energy phenomena in the solar system can be observed at various scales, using models to study systems that are too large. • • Engineering advances have led to important discoveries in space science, and scientific discoveries have led to the development of entire industries and engineered systems.	*Students who understand the concepts are able to:* • Analyze and interpret data to determine similarities and differences among objects in the solar system.

Connections to Other Units

Grade 6 Unit 4: 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).
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

Grade 6 Unit 5: Types of Interactions

- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
- 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.
- 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).

Grade 7 Unit 8: Earth 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.
- 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 its future.

Appendix A: NGSS and Foundations for the Unit
Generate and analyze evidence (through simulations or long term investigations) to explain why the Sun's apparent motion across the sky changes over the course of a year. (ESS1.B)
Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. *[Clarification Statement: Examples of models can be physical, graphical, or conceptual.]* **(MS-ESS1-1)**
Develop and use a model that shows how gravity causes smaller objects to orbit around larger objects at increasing scales, including the gravitational force of the sun causes the planets and other bodies to orbit around it holding together the solar system. (ESS1.A; ESS1.B)
Analyze and interpret data to determine scale properties of objects in the solar system. *[Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]* **(MS-ESS1-3)**
Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. *[Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]* **(MS-ESS1-2)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. (MS-	**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	**Patterns** • Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to

ESS1-3)	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)	study systems that are too large or too small. (MS-ESS1-3) **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)

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3) **RST.6-8.1**	Reason abstractly and quantitatively. (MS-ESS1-3) **MP.2** Model with mathematics. (MS-ESS1-1),(MS-ESS1-2) **MP.4**

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) **RST.6-8.7** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS1-1),(MS-ESS1-2) **SL.8.5**	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) **6.RP.A.1** Recognize and represent proportional relationships between quantities. (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3) **7.RP.A.2** 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.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-ESS1-2)* **7.EE.B.6**

Unit 6: Astronomy (20 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
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. ESS1.B Generate and analyze evidence (through simulations or long term investigations) to explain why the Sun's apparent motion across the sky changes over the course of a year. ESS1.A; ESS1.B Develop and use a model that shows how gravity causes smaller objects to orbit around larger objects at increasing scales, including the gravitational force of the sun causes the planets and other bodies to orbit around it holding together the solar system.	1. Phases of the Moon 2. Gravity and Orbits 3. Seasons and Tides	1. http://betterlesson.com/lesson/636034/phases-of-the-moon 2. https://phet.colorado.edu/en/contributions/view/3401 3. http://betterlesson.com/lesson/645433/seasons-tides
MS-ESS1-2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	4. Gravity 5. My Solar System	4. http://betterlesson.com/lesson/645431/gravity 5. https://phet.colorado.edu/en/simulation/legacy/my-solar-system
MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.	2. Gravity and Orbits	2. https://phet.colorado.edu/en/contributions/view/3401

1. Phases of the Moon- SWBAT create a model to show how the regular motions of the Moon cause Moon phases.

2. Gravity and Orbits- SWBAT move the sun, earth, moon and space station to see how it affects their gravitational forces and orbital paths. Visualize the sizes and distances between different heavenly bodies, and turn off gravity to see what would happen without it.

3. Seasons & Tides- SWBAT explain how the movements and distances (perigee, apogee) between Earth and Moon produce tides including the relationship between phases and tides and tidal bulge and rate of lunar revolutions and 2) Explain how revolution, rotation, and precession of the Sun-Moon-Earth system produce changes in the solar angle of incidence (altitude, azimuth) that result in seasons (solstices and equinoxes) and changes in the length of a day, month (sidereal and synodic lunar month), and year.

4. Gravity- SWBAT describe the relationship between mass, distance and gravity for objects in the solar system. Using a variety of simulations and models, students come to understand the role of gravity as a governing force in the solar system.

5. My Solar System- SWBAT Build your own system of heavenly bodies and watch the gravitational ballet. With this orbit simulator, you can set initial positions, velocities, and masses of 2, 3, or 4 bodies, and then see them orbit each other.

Unit 7: Weather and Climate

Unit Summary

What factors interact and influence weather and climate?

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 and climate. 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 though 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.

This unit is based on MS-ESS2-4, MS-ESS2-5, and MS-ESS2-6.

Student Learning Objectives

Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. *[Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]* **(MS-ESS2-4)**

Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. *[Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]* **(MS-ESS2-5)**

Explain how variations in density result from variations in temperature and salinity drive a global pattern of interconnected ocean currents. *[Note: This SLO is based on a disciplinary core idea found in the Framework. It is included as a scaffold to the following SLO.]* (ESS2.C)

Use a model to explain the mechanisms that cause varying daily temperature ranges in a coastal community and in a community located in the interior of the country. *[Note: This SLO is based disciplinary core ideas found in the Framework. It is included as a scaffold to the following SLO.]*

(ESS2.C; ESS2.D)
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. *[Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]* **(MS-ESS2-6)**

Unit Sequence	
Part A: *What are the processes involved in the cycling of water through Earth's systems?*	
Concepts	**Formative Assessment**
• 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. • Model the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle.

Unit Sequence	
Part B: *What is the relationship between the complex interactions of air masses and changes in weather conditions?*	
Concepts	**Formative Assessment**
• 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 temperatures and currents, are major determinants of local weather	*Students who understand the concepts are able to:* • Collect data to serve as the basis for evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

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.	

Unit Sequence	
Part C: *What are the major factors that determine regional climates?*	
Concepts	**Formative Assessment**
• 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 Coriolis effect and the outlines of	*Students who understand the concepts are able to:* • 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.

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.	

Connections to Other Units

Grade 6 Unit 1: 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.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

Grade 6 Unit 2: Interactions 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.
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

Grade 6 Unit 4: 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).
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen

units of size. In order to share information with other people, these choices must also be shared.

Grade 6 Unit 5: Types of Interactions

- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
- 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.
- 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)

Grade 8 Unit 5: Relationships among Forms 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.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Grade 8 Unit 6: Thermal 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.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- 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.

Grade 8 Unit 7: The Electromagnetic Spectrum

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves.

Appendix A: NGSS and Foundations for the Unit
Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. *[Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]* **(MS-ESS2-4)**
Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. *[Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]* **(MS-ESS2-5)**
Explain how variations in density result from variations in temperature and salinity drive a global pattern of interconnected ocean currents. (ESS2.C)
Use a model to explain the mechanisms that cause varying daily temperature ranges in a coastal community and in a community located in the interior of the country. (ESS2.C; ESS2.D)
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. *[Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]* **(MS-ESS2-6)**
Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. *[Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]* **(MS-ESS2-4)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. (MS-ESS2-6) • Develop a model to describe unobservable mechanisms. (MS-ESS2-4) **Planning and Carrying Out Investigations** • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)	**ESS2.C: The Roles of Water in Earth's Surface Processes** • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) • 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) • Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) **ESS2.D: Weather and Climate** • 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)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) **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) **Energy and Matter** • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

	• 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)	

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-5),(MS-ESS3-5) **RST.6-8.1** 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-ESS2-5) **RST.6-8.9** 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-ESS2-5) **WHST.6-8.8** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-6) **SL.8.5**	Reason abstractly and quantitatively. (MS-ESS2-5),(MS-ESS3-5) **MP.2** 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-ESS2-5) **6.NS.C.5** 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-ESS3-5) **6.EE.B.6**

Unit 7: Weather and Climate (20 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
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.	1. Clouds and dew point activity 2. Water cycle model 3. Water cycle narrative	1. http://betterlesson.com/lesson/638295/clouds-and-dew-point-labs 2. http://betterlesson.com/lesson/638308/modeling-watersheds 3. http://betterlesson.com/lesson/637314/journey-through-the-water-cycle
MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. ESS2.C Explain how variations in density result from variations in temperature and salinity drive a global pattern of interconnected ocean currents ESS2.C; ESS2.D Use a model to explain the mechanisms that cause varying daily temperature ranges in a coastal community and in a community located in the interior of the country.	4. Modeling weather fronts 5. Weather forecasting web-quest	4. http://betterlesson.com/lesson/638294/modeling-weather-fronts 5. http://betterlesson.com/lesson/638300/weather-forecasting-online-activity
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.	6. Ocean currents change our Earth 7. The great ocean conveyor 8. Ocean currents 9. Global ocean and atmospheric circulation models	6. Attachment 7. Attachment 8. Attachment 9. http://betterlesson.com/lesson/638297/global-ocean-and-atmospheric-circulation-evaluating-models

1. Students will read an informational text on humidity, clouds, and dew point. Students will then participate in an activity where they will determine the dew point in the room and create a cloud in a bottle.

2. Students will model how the cycling of water through Earth's systems is driven by the sun and the force of gravity *using everyday materials.*

3. *Students will write a first person narrative of the water cycle, from the perspective of a water molecule.*

4. *Students will develop models of warm and cold fronts using water of different temperatures, and will then use the models to make predictions about weather patterns.*

5. *Students will complete a web-quest to analyze various weather maps and data tables to predict changes in weather.*

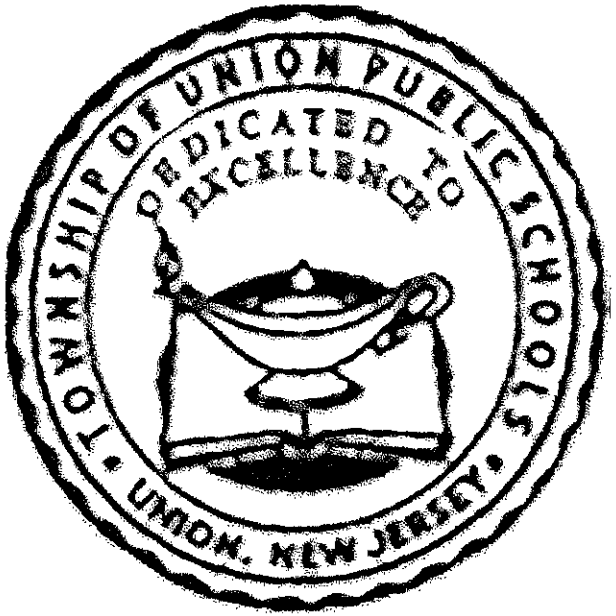
6. *Students investigate how the salinity of water affects density.*

7. *Students investigate how salt affects the flow of water through the oceans.*

8. Students will learn about the influences of wind, water temperature, landmasses, and water density on currents by carrying out an investigation.

9. Students will combine information they gained from models, videos, demonstrations, and articles, to explain how the rotation and uneven heating of the Earth cause patterns of oceanic and atmospheric circulation.

TOWNSHIP OF UNION PUBLIC SCHOOLS



7th Grade Science

Curriculum Guide

2016

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Academic Area

Science

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Mission Statement

The mission of the Township of Union Public Schools is to build on the foundations of honesty, excellence, integrity, strong family, and community partnerships. We promote a supportive learning environment where every student is challenged, inspired, empowered, and respected as diverse learners. Through cultivation of students' intellectual curiosity, skills and knowledge, our students can achieve academically and socially, and contribute as responsible and productive citizens of our global community.

Philosophy Statement

The Township of Union Public School District, as a societal agency, reflects democratic ideals and concepts through its educational practices. It is the belief of the Board of Education that a primary function of the Township of Union Public School System is the formulation of a learning climate conducive to the needs of all students in general, providing therein for individual differences. The school operates as a partner with the home and community.

Science Department Mission

The goal of the Union Township Science Department is to expose students to the different branches of science through the use of labs, modern technology, and field experiences. We aspire to develop scientific literacy in all students, allowing them to utilize problem solving and critical thinking skills. Students are encouraged to untap their potential by engaging in inquiry-based activities and experiments. When students develop a deep understanding of science they can truly appreciate the world in which they live.

Science Department Vision

We aspire to encourage creativity and imagination, as it allows students to explore the world around them on their own. Our classrooms are conducive to student learning and our activities are student centered. At Union Township we expect highly of our staff and students and uphold them to high standards. We would like to see students pursue science in college, their career choice, or personal interests.

Statement of District Goals

- Develop reading, writing, speaking, listening, and mathematical skills.
- Develop a pride in work and a feeling of self-worth, self-reliance, and self discipline.
- Acquire and use the skills and habits involved in critical and constructive thinking.
- Develop a code of behavior based on moral and ethical principals.
- Work with others cooperatively.
- Acquire a knowledge and appreciation of the historical record of human achievement and failures and current societal issues.
- Acquire a knowledge and understanding of the physical and biological sciences.
- Participate effectively and efficiently in economic life and the development of skills to enter a specific field of work.
- Appreciate and understand literature, art, music, and other cultural activities.
- Develop an understanding of the historical and cultural heritage.
- Develop a concern for the proper use and/or preservation of natural resources.
- Develop basic skills in sports and other forms of recreation.

Course Description

The seventh grade elaborates upon and deepens the concepts of the spiral of physical, life and earth science. This "spiral of knowledge" engenders the continuity of connections between and among the sciences aforementioned.

During the physical science unit students will learn about the structure and properties of matter, interactions of matter, and chemical reactions.

During the life science unit students will learn about the structure and function of living things, body systems, inheritance and variation of traits as well as the organization for matter and energy flow in organisms.

During the earth science unit students will learn about the Earth's systems.

The seventh grade science curriculum is a link in the chain of knowledge that will allow our students to be empowered, life time learners.

Course Proficiencies- Seventh Grade Science

Unit 1: Structure and Properties of Matter

- Develop models to describe the atomic composition of simple molecules and extended structures. MS-PS1-1
- Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-2

Unit 2: Interactions of Matter

- Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. MS-PS1-3
- 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. MS-PS1-4

Unit 3: Chemical Reactions

- 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-PS1-5
- Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. MS-PS1-6
- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. MS-ETS1-3

Unit 4: Structure and Function

- Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells. MS-LS1-1
- Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. MS-LS1-2

Unit 5: Body Systems

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

Unit 6: Inheritance and Variation of Traits

- 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-LS3-1
- 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-LS3-2

Unit 7: Organization for Matter and Energy Flow in Organisms

- 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. MS-LS1-6
- Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. MS-LS1-7

Unit 8: Earth Systems

- 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-ESS1-4
- Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS2-1
- Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. MS-ESS2-2
- Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. MS-ESS2-3

Curriculum Units – Seventh Grade Science

- **Unit 1**: Structure and Properties of Matter
- **Unit 2**: Changes in Matter
- **Unit 3**: Chemical Reactions
- **Unit 4**: Structure, Function, and Information Processing
- **Unit 5**: Body Systems
- **Unit 6**: Inheritance and Variations of Traits
- **Unit 7**: Organization for Matter and Energy Flow in Organisms
- **Unit 8**: Earth Systems

Pacing Guide- Seventh Grade Science

Unit 1: Structure and Properties of Matter **Instructional Days: 20**

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

This unit is based on MS-PS1-1 and MS-PS1-2.

Unit 2: Interactions of Matter **Instructional Days: 20**

Students provide molecular-level accounts of states of matter 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 are also able to apply an understanding of optimization design and process in engineering to chemical reaction systems. The crosscutting concepts of *structure and function, cause and effect, interdependence of science, engineering, and technology, and influence of science, engineering, and technology on society and on the natural world* provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate grade appropriate proficiency in *obtaining, evaluating, and communicating information* and *developing and using models*. Students are also expected to use the scientific and engineering practices to demonstrate understanding of the core ideas.

This unit is based on MS-PS1-3 and MS-PS1-4.

Unit 3: Chemical Reactions **Instructional Days: 25**

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.

This unit is based on MS-PS1-5, MS-PS1-6, MS-ETS1-2, MS-ETS1-3, and MS-ETS1-4.

Unit 4: Structure and Function **Instructional Days: 15**

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 to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

This unit is based on MS-LS1-1 and MS-LS1-2.

Unit 5: Body Systems **Instructional Days: 15**

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 crosscuttings 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.

This unit is based on MS-LS1-3 and MS-LS1-8.

Unit 6: Inheritance and Variation of Traits **Instructional Days: 20**

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.

This unit is based on MS-LS3-1 and MS-LS3-2.

Unit 7: Organization for Matter and Energy Flow in Organisms **Instructional Days: 15**

Students provide a mechanistic account for how cells provide a structure for the plant process of photosynthesis in the movement of matter and energy needed for the cell. Students use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They construct scientific explanations for the cycling of matter in organisms and the interactions of organisms to obtain matter and energy from an ecosystem to survive and grow. They understand that sustaining life requires substantial energy and matter inputs, and that the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy. The crosscutting concepts of *matter and energy* and *structure and function* provide a framework for understanding of the cycling of matter and energy flow into and out of organisms. Students are also expected to demonstrate proficiency in *developing and using models*. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

This unit is based on MS-LS1-6 and MS-LS1-7.

Unit 8: Earth Systems **Instructional Days: 30**

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.

This unit is based on MS-ESS1-4, MS-ESS2-1, MS-ESS2-2, and MS-ESS2-3.

Unit 1: Structure and Properties of Matter

Unit Summary

How is it that everything is made of star dust?

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

Student Learning Objectives

Develop models to describe the atomic composition of simple molecules and extended structures. *[Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. The substructure of atoms and the periodic table are learned in high school chemistry.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]* **(MS-PS1-1)**

Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. *[Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]* **(MS-PS1-2)**

Unit Sequence	
***Part A:** If the universe is not made of Legos®, then what is it made of?*	
Concepts	**Formative Assessment**
• Substances are made from different types of atoms. ✓ 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. • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	*Students who understand the concepts are able to:* • Develop a model of a simple molecule. • Use the model of the simple molecule to describe its atomic composition. • Develop a model of an extended structure. • Use the model of the extended structure to describe its repeating subunits. *[Boundary: The substructure of atoms and the periodic table are learned in high school chemistry.]*

Unit Sequence	
Part B: *Is it possible to tell if two substances mixed or if they reacted with each other?*	
Concepts	**Formative Assessment**
• Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. • Substances react chemically in characteristic 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. • Density, melting point, boiling point, solubility, flammability, and odor are characteristic properties that can be used to identify a pure substance. • Macroscopic patterns are related to the nature of the atomic-level structure of a substance.	*Students who understand the concepts are able to:* • Analyze and interpret data to determine similarities and differences from results of chemical reactions between substances before and after they undergo a chemical process. • Analyze and interpret data on the properties of substances before and after they undergo a chemical process. • Identify and describe possible correlation and causation relationships evidenced in chemical reactions. • Make logical and conceptual connections between evidence that chemical reactions have occurred and explanations of the properties of substances before and after they undergo a chemical process.

Connections to Other Units

Unit 2: Interactions 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.
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.

Unit 3: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Appendix A: NGSS and Foundations for the Unit

Develop models to describe the atomic composition of simple molecules and extended structures. *[Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. The substructure of atoms and the periodic table are learned in high school chemistry.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]* **(MS-PS1-1)**

Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. *[Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]* **(MS-PS1-2)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to predict and/or describe phenomena. (MS-PS1-1) **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)	**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) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2)	**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) **Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) --- ***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-PS1-2)

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.(MS-PS1-2) **RST.6-8.1** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1),(MS-PS1-2) **RST.6-8.7**	Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2) **MP.2** Model with mathematics. (MS-PS1-1) **MP.4** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1),(MS-PS1-2) **6.RP.A.3** Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to

	express how many times as much one is than the other. (MS-PS1-1) **8.EE.A.3** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2) **6.SP.B.4** Summarize numerical data sets in relation to their context. (MS-PS1-2) **6.SP.B.5**

Unit 1: Structure and Properties of Matter (20 days)			
This unit is based on:	**SLO**	**Inquiry Menu**	**Quick Links**
MS-PS1-1	Develop models to describe the atomic composition of simple molecules and extended structures	1. Marshmallow Molecules 2. Building Atomic Models Simulation Investigation	1. http://betterlesson.com/lesson/634009/marshmallow-molecules 2. http://betterlesson.com/lesson/640284/building-atomic-models-simulation-investigation
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.	3. Chemical Reactions Un-Notes 4. Chemical vs Physical Change Stations	3. http://betterlesson.com/lesson/634016/chemical-reactions-un-notes 4. Attachment

1. Marshmallow Molecules – students use marshmallows and toothpicks to develop models of molecular structures! In addition, students utilize graphing to monitor their own learning. (Standards MS-PS1-1, SP2, SP8, Patterns)

2. Building Atomic Models Simulation Investigation – students will be able to describe the structure and function of parts of atoms by comparing the charge, location, and relative mass of protons, neutrons, and electrons. (Standards MS-PS1-1, SP2, SP4, Sp6, XC-SF-MS-1)
3. Chemical Reactions Un-Notes – students watch three exciting demonstrations that allow them to come up with signs of a chemical reaction on their own. (Standards MS-PS1-2, SP2, SP4, SP7, Patterns)
4. Chemical vs Physical Change Stations – students use their knowledge of the sings of a chemical change to identify whether a physical or chemical change is occurring at each station. (Standards MS-PS1-2, SP4, SP7)

Unit 2: Changes in Matter

Unit Summary

How can we trace synthetic materials back to natural ingredients?

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

Student Learning Objectives

Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. *[Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]* (MS-PS1-3)

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. *[Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]* (MS-PS1-4)

Unit Sequence	
Part A: How can you tell what the molecules are doing in a substance?	
Concepts	**Formative Assessment**
• Changes in particle motion, temperature, and state of a pure substance occur when thermal energy is added or removed. • Qualitative molecular-level models of solids, liquids, and gases can be used to show that adding or removing thermal energy increases or decreases the kinetic energy of the particles until a change of state occurs. • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. • In a liquid, the molecules are constantly in contact with others. • In a gas, the molecules are widely spaced except when they happen to collide. • In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. • The changes of state that occur with variations in temperature or pressure can be described and predicted using models of matter. • The term heat as used in everyday language refers both to thermal energy and the transfer of that thermal energy from one object to another. • Thermal energy is the motion of atoms or molecules within a substance. • In science, heat is used to refer to the energy transferred due to the temperature difference between two objects. • 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 the relationship between the average internal kinetic energy and the potential energy per atom or molecule depend on the type of atom or molecule and the interactions among the atoms in the material.	*Students who understand the concepts are able to:* • Develop a model that predicts and describes changes in particle motion that could include molecules or inert atoms or pure substances. • Use cause-and-effect relationships to predict changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural or designed systems.

• 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. • Cause-and-effect relationships may be used to predict and describe changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed in natural systems.	

Unit Sequence	
Part B: *How can we trace synthetic materials back to natural ingredients?*	
Concepts	**Formative Assessment**
• Each pure substance has characteristic physical and chemical properties that can be used to identify it. • Substances react chemically in characteristic ways. • In a chemical process, the atoms that make up the original substances are regrouped into different molecules. • New substances that result from chemical processes have different properties from those of the reactants. • Natural resources can undergo a chemical process to form synthetic material. • Structures can be designed to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. • Engineering advances have led to discoveries of important synthetic materials, and scientific discoveries have led to the development of entire industries and engineered systems using these materials. • Technology use varies from region to region and over time. • The uses of technologies (engineered/synthetic materials) and any limitations on their use are driven by individual or societal needs, desires, and values.	*Students who understand the concepts are able to:* • Obtain, evaluate, and communicate information to show that synthetic materials come from natural resources and affect society. • Gather, read, and synthesize information about how synthetic materials formed from natural resources affect society. • Assess the credibility, accuracy, and possible bias of each publication and methods used within the publication. • Describe how information about how synthetic materials formed from natural resources affect society is supported or not supported by evidence.

• The uses of technologies (engineered/synthetic materials) and any limitations on their use are driven by the findings of scientific research and by differences in such factors as climate, natural resources, and economic conditions.	

Connections to Other Units

Grade 7 Unit 1: Properties of Matter

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- 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.

Grade 7 Unit 3: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Appendix A: NGSS and Foundations for the Unit

Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. *[Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]* **(MS-PS1-3)**

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added

or removed. *[Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]* **(MS-PS1-4)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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-PS1-3) **Developing and Using Models** • Develop a model to predict and/or describe phenomena. (MS-PS1-4)	**PS1.A: Structure and Properties of Matter** • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) • 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) **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3) **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the	**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) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) --- ***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-PS1-3) **Influence of Science, Engineering and**

	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)*	**Technology on Society and the Natural World** • The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by 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)

English Language Arts	**Mathematics**
Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS1-3) **RST.6-8.1** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). *(MS-PS1-4)* **RST.6-8.7** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4) **6.NS.C.5**

3) WHST.6-8.8	

Unit 2: Interactions of Matter (20 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
MS-PS1-3	Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	1. Separating Mixtures: Discovery 2. Better Than Gold	1. http://betterlesson.com/lesson/640780/separating-mixtures-discovery 2. http://betterlesson.com/lesson/639724/better-than-gold
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.	3. Talk About Burning Your Money! 4. Racing Molecules!	3. http://betterlesson.com/lesson/634014/talk-about-burning-your-money-phase-changes-endothermic-and-exothermic-reactions 4. http://betterlesson.com/lesson/635350/racing-molecules

1. Separating Mixtures: Discovery The purpose of this lesson is to let students discover that all substances originally come from the earth. This lesson leaves a lot of room for student engagement and discussion. Students have the opportunity to explore the concept that all substances come from the Earth originally, that methods have to be used to separate the materials from the Earth, and that these methods could be harmful to land and people.

2. Better Than Gold This lesson is a bit different from all the others as it is based solely on reading comprehension based on a scientific topic. It is based on building "contextual and background knowledge," while incorporating significant vocabulary pertaining to this unit: e*lement, mining, rare Earth elements, metals, brine, evaporate, crust.* I like this activity because it takes a step back, allows students to read and have discussion amongst their peers, while using the 6.2, 6.3, 6.10 crosscutting concepts –all pertaining to where some of our most valuable minerals come from.

3. Talk About Burning Your Money! This lesson starts with the nuts and bolts of understanding the structure of an atom to identifying what happens during an endothermic or exothermic reaction. **Science and Engineering Practices:** In reading and completing the "Let's Get Physical With Phase Changes" document, students use strategies to obtain scientific information and evidence from text (**SP7**). In addition,

during class discussion, students back up their explanations in the lab document with evidence from their qualitative observations (**SP8**). **Crosscutting Concepts:** When students discuss what they saw in the lab in comparison to what they read in the text, students can begin to see patterns in the way that the state of matter and the molecular arrangement can change when thermal energy is added or removed. Thus, students can begin to see that macroscopic patterns are related to the nature of microscopic and atomic-level structure (**Patterns**). In creating patterns of energy transfer that occur in both phase changes and endothermic and exothermic reactions, students track how energy moves during various phase changes (**Energy and Matter**). Students eventually get the chance to "burn their money!" Students should eventually determine that the water evaporates as the rubbing alcohol burns. When the water evaporates it takes energy in from the dollar bill in order to burn, thus lowering the temperature of the dollar bill. Evaporation is an endothermic reaction that makes the surroundings (the dollar bill) feel colder.

4. Racing Molecules! Students know that all matter is made up of atoms and atoms have energy. They are constantly in motion. Just how much faster are atoms in warm water compared to atoms in warm water? And if we could measure their speed how fast do they move - faster than a car, the speed of sound, the speed of light? Students will measure the difference in the speed of atoms in water of different temperatures. The lesson closes with a discussion based around which has more heat energy? A Bill Nye The Science Guy video is shown, where students can learn that all things hot and cold have heat energy. The amount of heat energy is related to the size of the object. Although the match feels warmer, it cannot melt the larger ice sculpture

Unit 3: Chemical Reactions

Unit Summary
How do substances combine or change (react) to make new substances?   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

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. *[Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]* **(MS-PS1-5)**
Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* *[Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]* **(MS-PS1-6)**
Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

Unit Sequence	
Part A: *What happens to the atoms when I bake a cake?*	
Concepts	**Formative Assessment**
• Substances react chemically in characteristic ways. • In a chemical process, the atoms that make up the original substances are regrouped into different molecules. • 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). • 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.	*Students who understand the concepts are able to:* • Use physical models or drawings, including digital forms, to represent atoms in a chemical process. • Use mathematical descriptions to show that the number of atoms before and after a chemical process is the same.

Unit Sequence	
Part B: *How can a device be designed, constructed, tested, and modified that either releases or absorbs thermal energy by chemical processes?*	
Concepts	**Formative Assessment**
• 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 to for it to be improved. • 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. • Some of the characteristics identified as having the best performance may be incorporated into the new design.	*Students who understand the concepts are able to:* • Undertake a design project, engaging in the design cycle, to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. • Specific criteria are limited to amount, time, and temperature of a substance. • Analyze and interpret data for the amount, time, and temperature of a substance in testing a device that either releases or absorbs thermal energy by chemical processes to determine similarities and differences in findings. • Develop a model to generate data for testing a device that either releases or absorbs thermal energy by chemical processes, including those representing inputs and outputs of thermal energy. • Track the transfer of thermal energy as energy flows through a designed system that either releases or absorbs thermal energy by chemical processes.

Connections to Other Units
Grade 7 Unit 1: Properties of Matter • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. • 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.

Grade 7 Unit 2: Interactions of Matter

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.

Appendix A: NGSS and Foundations for the Unit

Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. *[Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]* **(MS-PS1-5)**

Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* *[Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]* **(MS-PS1-6)**

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

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop a model to describe unobservable mechanisms. (MS-PS1-5) **Constructing Explanations and Designing Solutions** • Undertake a design project, engaging in the design cycle, to construct and/or implement	**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-PS1-5)	**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 natural system. (MS-PS1-6)

a solution that meets specific design criteria and constraints. (MS-PS1-6) **Analyzing and Interpreting Data** • Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)	• 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*) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (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) **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) • Although one design may not perform the	**Connections to Nature of Science** **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** • Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

	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)	

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-3) **RST.6-8.1** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6) **RST.6-8.3** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-5) **RST.6-8.7** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-3) **RST.6-8.9** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6) (MS-ETS1-3) **WHST.6-8.7** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-5) **6.RP.A.3**	Reason abstractly and quantitatively. (MS-PS1-5) (MS-ETS1-3) **MP.2** Model with mathematics. (MS-PS1-5) **MP.4** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-3) **7.EE.3**

Unit : 3 Chemical Reactions			
This unit is based on:	**SLO**	**Inquiry Menu**	**Quick Links**
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.	1. Law of Conservation of Matter Lab 2. Law of Conservation of Matter #2 3. Balancing equations	1. http://betterlesson.com/lesson/603857/what-is-conservation-of-matter 2. http://betterlesson.com/lesson/641851/conservation-of-mass-investigation 3. http://betterlesson.com/lesson/631279/balancing-equations
MS-PS1-6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.	4. Design a self- heating or cooling device 5. Design a Cool Pack - activity	4. Attachment 5. Attachment
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.	(This SLO is met by the summative projects listed above)	(see attachments 4 and 5)

1. Students will carry out a chemical reaction in a closed container and an open container and compare the mass of the products. They will then model the reaction using paper cuts outs/etc. Then, students will answer analysis questions.
2. Students will carry out an investigation to show that mass is conserved in both physical and chemical changes using glow sticks and freezer pops.
3. Students will practice balancing equations using an interactive website.

4. Students will first observe various reactions and classify them as either exothermic or endothermic. Students will then choose chemicals to use the "design" a self heating or cooling device, and present their product, based on evidence collected from the initial lab investigation. Students will also revisit MS-PS1-5 as part of this summative project.
5. Students will carry out an investigation to help them develop and design a lab to test endothermic reactions, and use the data to design a cool pack based on their observations.

Unit 4: Structure, Function, and Information Processing

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 to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.
Student Learning Objectives
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-LS1-1)**
Develop and use a model to describe the function of a cell as a whole and ways 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-LS1-2)

Unit Sequence	
Part A: How will astrobiologists know if they have found life elsewhere in the solar system?	
Concepts	**Formative Assessment**
• Distinguish between living and nonliving things. • Cells are the smallest unit of life that can be said to be alive. • All living things are made up of cells, either one cell or many different numbers and types of cells. • Organisms may consist of one single cell (unicellular). • Nonliving things can be composed of cells. • Organisms may consist of many different numbers and types of cells (multicellular). • Cells that can be observed at one scale may not be observable at another scale. • Engineering advances have led to important discoveries in the field of cell • biology, and scientific discoveries have led to the development of entire industries and engineered systems.	*Students who understand the concepts are able to:* • Conduct an investigation to produce data that provides evidence distinguishing between living and nonliving things. • Conduct an investigation to produce data supporting the concept that living things may be made of one cell or many and varied cells. • Distinguish between living and nonliving things. • Observe different types of cells that can be found in the makeup of living things.

Unit Sequence	
Part B: How do the functions of cells support an entire organism?	
Concepts	**Formative Assessment**
• The cell functions as a whole system. • Identify parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. • Within cells, special structures are responsible for particular functions. • Within cells, the cell membrane forms the boundary that controls	*Students who understand the concepts are able to:* • Develop and use a model to describe the function of a cell as a whole. • Develop and use a model to describe how parts of cells contribute to the cell's function. • Develop and use models to describe the relationship between the

what enters and leaves the cell. • Complex and microscopic structures and systems in cells can be visualized, modeled, and used to describe how the function of the cell depends on the relationships among its parts. • Complex natural structures/systems can be analyzed to determine how they function. • 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 contribute to the cell's function. • The structures of the cell wall and cell membrane are related to their function.	structure and function of the cell wall and cell membrane.

Connections to Other Units

Grade 7 Unit 6: Inheritance and Variation 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.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- In sexually reproducing organisms, each parent contributes half of the genes 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.
- 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.

Grade 7 Unit 8: Earth 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.
- 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 its future.

Appendix A: NGSS and Foundations for the Unit

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-LS1-1)**

Develop and use a model to describe the function of a cell as a whole and ways 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-LS1-2)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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) **Developing and Using Models** • Develop a model to describe phenomena. (MS-LS1-2)	**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)	**Scale, Proportion, and Quantity** • Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) **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) --- ***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-LS1-1)

English Language Arts	**Mathematics**
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-LS1-1) **WHST.6-8.7** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2) **SL.8.5**	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-LS1-1),(MS-LS1-2) **6.EE.C.9**

Unit 4:Structure and Function (15 days)			
This unit is based on:	**SLO**	**Inquiry Menu**	**Quick Links**
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.	1. Microscope Mania (Day 1) 2. Microscope Mania (Day 2) 3. Cells the basic building blocks of Living Things 4. Eukaryotes & prokaryotes- Similarities and differences	1. http://betterlesson.com/lesson/638282/microscope-mania-part-1- 2. http://betterlesson.com/lesson/639744/microscope-mania-day-part-2-2 3. http://betterlesson.com/next_gen_science/browse/2216/ngss-ms-ls1-1-conduct-an-investigation-to-provide-evidence-that-living-things-are-made-of-cells-either-one-cell-or-many-different

			4. http://betterlesson.com/lesson/626286/eukaryotes-and-prokaryotes-similarities-and-differences
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.	5. Cells to Tissues to Organs 6. Insane in the membrane 7. The Incredible edible cell	5. http://betterlesson.com/lesson/632404/cells-to-tissues-to-organs 6. http://betterlesson.com/lesson/638622/insane-in-the-membrane 7. http://betterlesson.com/lesson/638284/the-incredible-edible-cell

1. Students are introduced to Cell Theory as they read text through the lens of the NGSS Crosscutting Concepts in order to make deep connections and generate questions they have surrounding the content. Then, students look at living and nonliving things under microscopes. **This lesson is specifically designed to meet the following NGSS: 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.
2. On Day 2 of this lesson, students support claims with evidence as they write a scientific argument. **This lesson is specifically designed to meet the following NGSS: 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.
3. The purpose of this activity is to **engage** students in a new concept (cell biology) through the use of an animation to promote curiosity, generate enthusiasm and elicit prior knowledge. **This lesson is specifically designed to meet the following NGSS: 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.
4. In the first 5 minutes of class students read an article that discusses about the benefit of a "wimpy" handshake. This lesson follows a lesson that introduces students to prokaryotes and its most famous example, bacteria. The rationale for using this article, besides its interesting topic (rate of bacteria transfer depending on type of handshake), is that it connects the previous lesson to today's lesson. In addition, it's an article that everyone can relate to since handshaking is a daily occurrence for most people. **This lesson is specifically designed to meet the following NGSS: 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.
5. In this lesson use pieces of wooden train track are used as a visual for students. Alternatively, you could use Legos or K'NEX to build a house, beads and pieces of string to create a necklace or a small puzzle. The purpose is to illustrate how to use the different pieces to go from single cell to a class "organism". The manipulative aspect of this lesson is important for students to be able to develop a conceptual model to represent and understand the concept being taught (SP2). **This lesson is specifically designed to meet the following NGSS: 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.

6. In this lesson, students use reading strategies to learn about the structure and function relationship in the cell membrane as they create a model of membranes using soap bubbles. This lesson is specifically designed to address the following: 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.
7. In this lesson, students create a model of a cell using candy as they connect the structure of the candy to the structure and function of cell organelles. This lesson is specifically designed to address the following NGSS: 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.

Unit 5: Body Systems

Unit Summary
What are humans made of? 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 crosscuttings 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
Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. *[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.]* [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*]* **(MS-LS1-3)**
Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage

as memories. *[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]* (MS-LS1-8)

Unit Sequence	
Part A: *What is the evidence that a body is actually a system of interacting subsystems composed of groups of interacting cells?*	
Concepts	**Formative Assessment**
• In multicellular organisms, the body is a system of multiple, interacting subsystems. • Subsystems are groups of cells that work together to form tissues. • Organs are groups of tissues that work together to perform 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 systems. • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.	*Students who understand the concepts are able to:* • Use an oral and written argument supported by evidence to support or refute an explanation or a model of how the body is a system of interacting subsystems composed of groups of cells.

Unit Sequence	
Part B: *How do organisms receive and respond to information from their environment?*	
Concepts	**Formative Assessment**
• 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.	*Students who understand the concepts are able to:* • Gather, read, and synthesize information from multiple appropriate sources about sensory receptors' response to stimuli. • Assess the credibility, accuracy, and possible bias of each publication and methods used. • Describe how publications and methods used are supported or not

• Cause-and-effect relationships may be used to predict response to stimuli in natural systems.	supported by evidence.

Connections to Other Units

Grade 7 Unit 4: 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).
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.

Grade 7 Unit 6: Inheritance and Variation 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.
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- In sexually reproducing organisms, each parent contributes half of the genes 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.
- 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.

Appendix A: NGSS and Foundations for the Unit

Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. *[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.]* [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*]* **(MS-LS1-3)**

Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. *[*Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.*]* **(MS-LS1-8)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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) **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)	**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) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8) --- ***Connections to Nature of Science*** **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)

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3) **RST.6-8.1** 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) **RI.6.8** Write arguments focused on discipline content. (MS-LS1-3) **WHST.6-8.1** 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) **WHST.6-8.8**	N/A

Unit 5: Body Systems (15 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
MS-LS1-3	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells	1. Cells to tissues to organs 2. The Organization of living Things: Structure/Function Relationships	1. http://betterlesson.com/lesson/632404/cells-to-tissues-to-organs 2. http://betterlesson.com/lesson/638623/the-organization-of-living-things-structure-function-relationships
MS-LS1-8	Gather and synthesize information that sensory receptors respond to stimuli	3. A Difference of Mind 4. Lets Talk-Introduction to	3. http://betterlesson.com/lesson/629170/a-difference-of-mind

	by sending messages to the brain for immediate behavior or storage as memories	Neurotransmission	4. http://betterlesson.com/lesson/631867/lets-talk-introduction-to-neurotransmission

1. Cells to Tissues to Organs: Students are able to relate single cells to tissues to organs to organ systems to organisms by creating an analogy using a model train(K'NEX or Legos to build a house could be substituted). Students will understand that body systems are made of tiny parts working together. (Standards: MS-LS1-1, MS-LS1-2, MS-LS1-3)
2. The Organization of living Things: Structure/Function Relationships: students research to identify the structure/function relationships that occur in cells, tissues, and organs. Students learn about how cells are grouped in living organisms and are introduced to how to determine if a website is a credible resource. (Standards: MS-LS1-3)
3. A Difference of Mind:_: Students work through a variety of stations to determine that there is a large variation in how different brains respond to situations/stimuli. (Standards: MS-LS1-8)
4. Lets Talk-Introduction to Neurotransmission: Students explore neurotransmission through a variety of activities including a kinesthetic model. Students create a large neuron and after learning the different parts have to put it together correctly. (Standards: MS-LS-1-2, MS-LS1-8)

Unit 6: Inheritance and Variations of Traits

Unit Summary
Why do kids look similar to their parents? 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

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. *[Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]* **(MS-LS3-1)**
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. *[Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]* **(MS-LS3-2)**

Unit Sequence

Part A: *How do structural changes to genes (mutations) located on chromosomes affect proteins or affect the structure and function of an organism?*

Concepts	Formative Assessment
• 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. • 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 affect the traits of the individual. • 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. • Changes in genetic material may result in the production of different proteins. • Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby	*Students who understand the concepts are able to:* • 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.

change traits. • 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 • Though rare, mutations may result in changes to the structure and function of proteins.	

Unit Sequence	
***Part B:** How do asexual reproduction and sexual reproduction affect the genetic variation of offspring?*	
Concepts	**Formative Assessment**
• 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. • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. • In sexually reproducing organisms, each parent contributes half of the genes 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. • 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.	*Students who understand the concepts are able to:* • Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information. • Develop and use a model to describe why sexual reproduction results in offspring with genetic variation. • Use models such as Punnett squares, diagrams, and simulations to describe the cause-and effect-relationship of gene transmission from parent(s) to offspring and resulting genetic variation.

Connections to Other Units
Grade 6 Unit 1: Growth, Development and Reproduction of Organisms • Animals engage in characteristic behaviors that increase the odds of reproduction.

- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.
- Genetic factors as well as local conditions affect the growth of the adult plant.

Grade 7 Unit 4: 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).
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.

Grade 8 Unit 2: Selection and Adaptation

- Natural selection leads to the predominance of certain traits in a population, and the suppression of others.
- 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.
- 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.

Appendix A: NGSS and Foundations for the Unit

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. *[Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]* (MS-LS3-1)

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. *[Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]* (MS-LS3-2)

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models • Develop and use a model to describe	LS1.B: Growth and Development of Organisms • Organisms reproduce, either sexually or asexually, and transfer their genetic	Structure and Function • Complex and microscopic structures and systems can be visualized, modeled, and

phenomena. (MS-LS3-1),(MS-LS3-2)	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 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)	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) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

English Language Arts	Mathematics
Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1),(MS-LS3-2) **RST.6-8.1** 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.6-8.4** 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) **RST.6-8.7** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1),(MS-LS3-2) **SL.8.5**	Model with mathematics. (MS-LS3-2) **MP.4** Summarize numerical data sets in relation to their context. (MS-LS3-2) **6.SP.B.5**

Unit 6: Inheritance and Variation of Traits (20 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
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	1. Mutations: How Gene Changes Can Lead to Harmful, Beneficial, or Neutral Effects. 2. Controversies in Genetics	1. http://betterlesson.com/lesson/617385/mutations-how-gene-changes-can-lead-to-harmful-beneficial-or-neutral-effects 2. http://betterlesson.com/lesson/635192/controversies-in-genetics-multiday-project AND http://mariana68.wix.com/genetics AND http://betterlesson.com/lesson/635308/controversies

	organism.		-in-genetics-presentations-and-panel-discussion
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.	3. Asexual reproduction 4. Investigating Reproductive Strategies	3. http://betterlesson.com/lesson/633954/asexual-reproduction 4. http://teach.genetics.utah.edu/content/evolution/files/ReproductiveStrategies.pdf

1. This lesson starts off with a short video clip from Spiderman where Peter Parker gets bit by the spider and students will have to respond: Based on the evidence gathered does a change in DNA sequence affect the characteristics of living things? Support claim with evidence gathered (CCC). Students take "Cornell Notes (example attached)" that goes along with mutations power point. Teacher goes into further explanation on the types of mutations such as mismatch, deletion and insertion by using paper strips (attached) and folding them according to directions in order to identify a DNA sequence as regular or one of the mutations type.
2. Students are presented with 4 topics from the video/ teacher website: http://mariana68.wix.com/genetics. Each member of the team will choose one of the given aspects of genetics to research: The use of forensics in criminal cases, Cloning, Genetically engineered food and Genetically testing for diseases to ultimately debate the question "How should the funding for each of the genetic topics be allotted?". Because this is a 2 week project students will hand in a Daily Project Work Report (attached). After research is completed each group will present their information while the other groups formulate questions based off of their presentations. With the questions formulated the next day the teacher holds a panel discussion utilizing these questions. For further reflection the teacher could have students construct an argument-from-evidence paper.
3. Start class by looking at a video clip that shows the three types of asexual reproduction and after watching hand out video sheet (attached) and have students utilize this as their guided notes. Students are then provided with two background essays where they will "write in the margins" by drawing illustrations of what they imagine these organisms to look like and writing down questions based off of the reading. (articles and writing in the margins technique is attached). After discussion students will be given exit slip (or could be a quiz/homework) with questions regarding class information (attached).
4. Each student is to work with a partner – to start, each group will be given an investigating reproductive strategies worksheet and two organism descriptions (both attached) - one produces asexually, and the other sexually. Each pair will read the descriptions and complete the comparison table on the worksheet provided. After every group finishes, they will post their worksheet somewhere in the room. Students will walk around the room and read the tables creating a list of general characteristics of organisms that produce asexually and sexually. When completed, as a class, compile a list of general characteristics and ask students to discuss the advantages and disadvantages of reproduction in their pairs. Add the advantages and disadvantages to the master list.

Unit 7: Organization for Matter and Energy Flow in Organisms

Unit Summary
How do some organisms turn electromagnetic radiation into matter and energy?   Students provide a mechanistic account for how cells provide a structure for the plant process of photosynthesis in the movement of matter and energy needed for the cell. Students use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They construct scientific explanations for the cycling of matter in organisms and the interactions of organisms to obtain matter and energy from an ecosystem to survive and grow. They understand that sustaining life requires substantial energy and matter inputs, and that the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy. The crosscutting concepts of *matter and energy* and *structure and function* provide a framework for understanding of the cycling of matter and energy flow into and out of organisms. Students are also 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
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.]* **(MS-LS1-6)**
Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. *[Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]* **(MS-LS1-7)**

Unit Sequence	
Part A: *What is the role of photosynthesis in the cycling of matter and flow of energy into and out of an organism?*	
Concepts	**Formative Assessment**
• 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.	*Students who understand the concepts are able to:* • Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based

• 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. • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. • Sugars produced by plants can be used immediately or stored for growth or later use. • Within a natural system, the transfer of energy drives the motion and/or cycling of matter.	on valid and reliable evidence obtained from sources (including the students' own experiments). • Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on 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.

Unit Sequence	
Part B: *How is food rearranged through chemical reactions to form new molecules that support growth and/or release energy as this matter moves through an organism?*	
Concepts	**Formative Assessment**
• Food is rearranged through chemical reactions, forming new molecules that support growth. • Food is rearranged through chemical reactions, forming new molecules that release energy as this matter moves through an organism. • Molecules are broken apart and put back together to form new substances, and in this process, energy is released. • Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. • In cellular respiration, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. • 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. • Matter is conserved during cellular respiration because atoms are conserved in physical and chemical processes.	*Students who understand the concepts are able to:* • Develop and use a model to describe how food is rearranged through chemical reactions.

Connections to Other Units

Grade 7 Unit 3: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Grade 7 Unit 4: Structure and Function

- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.

Grade 7 Unit 8: Earth 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.
- 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 its future.

Appendix A: NGSS and Foundations for the Unit

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.]* **(MS-LS1-6)**

Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. *[Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]* **(MS-LS1-7)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts

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-LS1-6) **Developing and Using Models** • Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-7)	**LS1.C: Organization for Matter and Energy Flow in Organisms** • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) • 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) **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) • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)	**Energy and Matter** • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6) • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7) --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)

English Language Arts	**Mathematics**
Cite specific textual evidence to support analysis of science and technical	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one

texts. (MS-LS1-6) **RST.6-8.1** Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6) **RST.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-LS1-6) **WHST.6-8.2** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-6) **WHST.6-8.9**	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) **6.EE.C.9**

Unit 7: Organization for Matter and Energy Flow in Organisms (15 days)			
This unit is based on:	**SLO**	**STEM**	**Quick Links**
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.	1. Photosynthesis - Plants' Greatest Gift 2. Photosynthesis Lab	1. http://betterlesson.com/lesson/628232/photosynthesis-plants-greatest-gift 2. http://peterhuntstemarin.weebly.com/photosynthesis-lab.html
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 this matter moves through an organism.	3. Cellular Respiration: Do Plants Breathe? 4. Eggselent Experiment	3. http://betterlesson.com/lesson/638286/cellular-respiration-do-plants-breathe 4. http://betterlesson.com/lesson/638287/eggselent-experiment

1. This lesson provided two helpful video clips to help students understand the reactants and products of photosynthesis and also contains instructions for teachers to conduct a "Starch Test" on a plant. The students observe a plant placed in complete darkness and how it loses its color because it can no longer undergo photosynthesis.
2. For this lab students experiment with various colored cellophane and light to see if the colors of light and its intensity affects the photosynthesis process.
3. Students set up a control experiment in which they test to see if Cellular Respiration actually occurs. In this experiment a control is set up with fake peas (plastic beads) and actual peas in a closed jar with some Bromothymol blue solution placed in a test tube. The students record their data for a period of a few days and realize that the Bromothymol blue solution turned yellow due to the gas exchange taking place with the **actual peas.**
4. Students observe active/passive diffusion take place by observing an egg. Prior to beginning the experiment the teacher will submerge the eggs in vinegar and afterwards let the students peel off the shell. The students then place the egg in different liquids (corn syrup, colored water, and regular water) each day to observe diffusion.

Unit 8: Earth Systems

Unit Summary
If no one was there, how do we know the Earth's history? ***What provides the forces that drive Earth's systems?*** 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

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. *[Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.]* [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.*]* **(MS-ESS1-4)**
Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. *[Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.]* [Assessment Boundary: Assessment does not include the identification and naming of minerals.*]* **(MS-ESS2-1)**
Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. *[Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]* **(MS-ESS2-2)**
Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. *[Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).]* [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.*]* **(MS-ESS2-3)**

Unit Sequence	
***Part A:** How do we know that the Earth is approximately 4.6-billion-year-old history?*	
Concepts	**Formative Assessment**
• The geologic time scale is used to organize Earth's 4.6-billion-year-old history. • Rock formations and the fossils they contain are used to establish	*Students who understand the concepts are able to:* • Construct a scientific explanation based on valid and reliable evidence from rock strata obtained from sources (including the students' own

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. • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	experiments). • Construct a scientific explanation based on rock strata 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.

Unit Sequence	
***Part B:** What drives the cycling of Earth's materials?*	
Concepts	**Formative Assessment**
• Energy drives the process that results in the cycling of Earth's materials. • The processes of melting, crystallization, weathering, deformation, and sedimentation act together to form minerals and rocks through the cycling of Earth's materials. • All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. • 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 change in Earth's natural systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.	*Students who understand the concepts are able to:* • Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Unit Sequence	
***Part C:** Do all of the changes to Earth systems occur in similar time scales?*	
Concepts	**Formative Assessment**
• 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	*Students who understand the concepts are able to:* • Construct a scientific explanation for how geoscience processes have changed Earth's surface at varying time and spatial scales based on

be large or small; many geoscience processes usually behave gradually but are punctuated by catastrophic events. • Geoscience processes shape local geographic features. • 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. • Interactions among Earth's systems have 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. • 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.	valid and reliable evidence obtained from sources (including the students' own experiments). • Construct a scientific explanation for how geoscience processes have changed Earth's surface at varying time and spatial scales based on 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. • Collect evidence about processes that change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges). • Collect evidence about processes that change Earth's surface at time and spatial scales that can be small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events.

Unit Sequence	
Part D: *How is it possible for the same kind of fossils to be found in New Jersey and in Africa?*	
Concepts	**Formative Assessment**
• Tectonic processes continually generate new sea floor at ridges and destroy old sea floor at trenches. • 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. • Patterns in rates of change and other numerical relationships can provide information about past plate motions. • The distribution of fossils and rocks, continental shapes, and sea floor structures to provide evidence of past plate motions. • Similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches) provide evidence of past plate motions.	*Students who understand the concepts are able to:* • • Analyze and interpret data such as distributions of fossils and rocks, continental shapes, and sea floor structures to provide evidence of past plate motions. • Analyze how science findings have been revised and/or reinterpreted based on new evidence about past plate motions.

Connections to Other Units

Grade 7 Unit 1: 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.
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).

Grade 7 Unit 2: Interactions of Matter

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
- 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.

Grade 7 Unit 3: Chemical Reactions

- The total number of each type of atom is conserved, and thus the mass does not change.
- Some chemical reactions release energy, others store energy.

Grade 8 Unit 4: Human Impacts on Earth Systems and Global Climate Change

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

Grade 8 Unit 5: Relationships among Forms of Energy

- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

Grade 7 Unit 8: Earth 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.

- 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 its future.

Appendix A: NGSS and Foundations for the Unit

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. *[Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.]* [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.] **(MS-ESS1-4)**

Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. *[Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.]* [Assessment Boundary: Assessment does not include the identification and naming of minerals.] **(MS-ESS2-1)**

Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. *[Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]* **(MS-ESS2-2)**

Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. *[Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).]* [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.] **(MS-ESS2-3)**

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

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models	**ESS1.C: The History of Planet Earth**	**Stability and Change**

• Develop and use a model to describe phenomena. (MS-ESS2-1) **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 nature operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4),(MS-ESS2-2) **Analyzing and Interpreting Data** • Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)	• 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) **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 its future. (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)	• Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1) **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-ESS1-4),(MS-ESS2-2) **Patterns** • Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3) --- ***Connections to Nature of Science*** **Scientific Knowledge is Open to Revision in Light of New Evidence** • Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)

English Language Arts	**Mathematics**
Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-4),(MS-ESS2-2) **RST.6-8.1** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and	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) **7.EE.B.4** Use variables to represent numbers and write expressions when solving a

analysis of relevant content. (MS-ESS1-4),(MS-ESS2-2) **WHST.6-8.2** 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.6-8.7** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3) **RST.6-8.9** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-1),(MS-ESS2-2) **SL.8.5**	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-ESS1-4),(MS-ESS2-2),(MS-ESS2-3) **6.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) **7.EE.B.6** Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3) **MP.2**

Unit : 8 Earth Systems			
This unit is based on:	**SLO**	**Inquiry Menu**	**Quick Links**
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	1. Geologic Time Mini-Project 2. DBQ – Oxygen in Earth's Atmosphere	1. http://betterlesson.com/lesson/637351/geologic-time-mini-project 2. Attachment
MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process	3. Rock Cycle Anticipatory question and notes 4. Weathering and Erosion Activity	3. http://betterlesson.com/lesson/635343/rock-cycle 4. Attachment
MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial	5. The Story of Earth – video 6. Impact of the meteor strike 7. Earthquake STEAM	5. https://www.youtube.com/watch?v=SYOarZKipnU 6. http://betterlesson.com/lesson/638788/history-of-earth-part-1-problem-solving

	scales		7. Attachment
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	8. A Plate Tectonics Puzzle 9. Modeling Sea-Floor Spreading Activity 10. Mid-ocean Ridge activity (interactive website)	8. http://www.amnh.org/explore/curriculum-collections/dinosaurs-activities-and-lesson-plans/plate-tectonics-puzzle 9. "Inside Earth" Textbook – p.31 10. http://oceanexplorer.noaa.gov/edu/learning/player/lesson02/l2la1.htm

1. Students will research units of Earth's history and present the events that occurred during that time frame to the class in the form of a travel brochure.
2. Students will read an article on how scientists use rock layers to determine when oxygen first appeared in Earth's atmosphere and answer questions based on the text.
3. Students will decide which of three statements about rocks they agree with, and justify their choice using evidence. A power-point is also provided to enhance the lesson (a video link is included as well).
4. Students will model weathering and erosion with a series of activities.
5. Students will watch (portions of) a video that explains how Earth formed and has been changing over the past 4.6 billion years.
6. Students will use a portion of the video from activity #5 to have students map out the cause and effect of a meteor landing and see that events may start locally but can end up having a global impact.
7. Earthquake STEAM – students research earthquake proof/safe building materials and structures, in cooperative groups they construct towers designed to withstand earthquake waves, towers are tested for their ability to withstand damage on an earthquake board
8. Students will use logic and the evidence to reconstruct the position of large islands and continents as they appeared 220 million years ago.
9. Students will use a model to explain how sea floor spreading adds material to the ocean floor.
10. This activity consists of naming the continents, identifying mid-ocean ridges, and determining the age of the ocean floor. Once you have labeled each map correctly, you should be able to answer the series of questions that follow the exercise. The final map will allow you to explore all of the maps using a slide scale located above each tab. Navigating with the slide will provide different views of the maps, which will help with understanding the relationship between the continents, mid-ocean ridges and the age of the ocean floor.