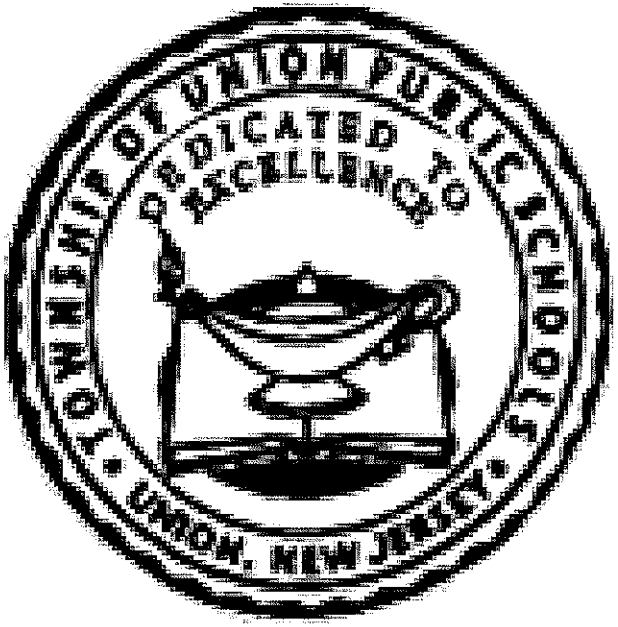
TOWNSHIP OF UNION PUBLIC SCHOOLS



6th Grade Science

Curriculum Guide

July 2018 Revised

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 mission of the **Burnet Science Department** in the Union Township Public School System is to prepare the students to become independent, lifelong learners who think critically, collaborate and persevere. We are determined to inspire our students to hypothesize, explore and investigate using the scientific method integrated with technology. Our vision is to produce a student who has the vision of him/herself as a responsible, enthusiastic, engaged member of the school community.

The goal of the **Kawameeh Middle School 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 reach their highest 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 life science unit students will learn about heredity and biological evolution. 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 , the history of the earth and evidence of common ancestry.

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: 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 2: Evidence of a Common Ancestry

- Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. MS-LS4-1
- Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. MS-LS4-2
- Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy MS-LS4-3

Unit 3: 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 4: 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 5: 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 6: Selection and Adaptation

- Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. MS-LS4-4
- Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. MS-LS4-5
- Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. MS-LS4-6.

Curriculum Units – Sixth Grade Science

- **Unit 1**: Astronomy
- **Unit 2**: Evidence of Common Ancestry
- **Unit 3**: Matter and Energy in Organisms and Ecosystems
- **Unit 4**: Interdependent Relationships in Ecosystems
- **Unit 5**: Heredity: Inheritance and Variation of Traits
- **Unit 6**: Selection and Adaptation

Pacing Guide- Sixth Grade Science

Instructional Days: 20

Unit 1: 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 2: Evidence of a Common Ancestry **Instructional Days: 15**

In this unit of study, students analyze graphical displays and gather evidence from multiple sources in order to develop an understanding of how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students search for patterns in the evidence to support their understanding of the fossil record and how those patterns show relationships between modern organisms and their common ancestors. The crosscutting concepts of *cause and effect, patterns*, and *structure and function* are called out as organizing concepts for these disciplinary core ideas. Students use the practices of *analyzing graphical displays* and *gathering, reading, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-LS4-1, MS-LS4-2, and MS-LS4-3.

Instructional Days: 25

Unit 3: 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 4: 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.

Unit 5: 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 6: Selection and Adaptation **Instructional Days: 20**

Students construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They will use ideas of genetic variation in a population to make sense of how organisms survive and reproduce, thus passing on the traits of the species. The crosscutting concepts of *patterns* and *structure and function* are called out as organizing concepts that students use to describe biological evolution. Students use the practices of *constructing explanations, obtaining, evaluating, and communicating information*, and *using mathematical and computational thinking*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-LS4-4, MS-LS4-5, and MS-LS4-6.

Unit 1: 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 8 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.

Grade8 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-ESS1-3)	**ESS1.A: The Universe and Its Stars** • Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1) • Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) **ESS1.B: Earth and the Solar System** • The solar system consists of the sun and a collection of objects, including planets, their	**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 study systems that are too large or too small. (MS-ESS1-3) **Systems and System Models** • Models can be used to represent systems

	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)	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** Integrate quantitative or technical information expressed in words in a	Reason abstractly and quantitatively. (MS-ESS1-3) **MP.2** Model with mathematics. (MS-ESS1-1),(MS-ESS1-2) **MP.4**

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 1: 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	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**

	gravitational force of the sun causes the planets and other bodies to orbit around it holding together the solar system.		
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 2: Evidence of Common Ancestry

Unit Summary
How do we know when an organism (fossil) was alive? ***How do we know that birds and dinosaurs are related?*** In this unit of study, students analyze graphical displays and gather evidence from multiple sources in order to develop an understanding of how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students search for patterns in the evidence to support their understanding of the fossil record and how those patterns show relationships between modern organisms and their common ancestors. The crosscutting concepts of *cause and effect, patterns*, and *structure and function* are called out as organizing concepts for these disciplinary core ideas. Students use the practices of *analyzing graphical displays* and *gathering, reading, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas. This unit is based on MS-LS4-1, MS-LS4-2, and MS-LS4-3.
Student Learning Objectives
Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. *[Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]* **(MS-LS4-1)**
Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. *[Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]* **(MS-LS4-2)**
Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. *[Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]* **(MS-LS4-3)**
Unit Sequence

Part A: *How do we know when an organism (fossil) was alive?*	
Concepts	**Formative Assessments**
• The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. • The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found or through radioactive dating is known as the fossil record. • Relative fossil dating is achieved by examining the fossil's relative position in sedimentary rock layers. • Objects and events in the fossil record occur in consistent patterns that are understandable through measurement and observation. • Patterns exist in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in rock layers. • Patterns can occur within one species of organism or across many species.	*Students who understand the concepts can:* • Use graphs, charts, and images to identify patterns within the fossil record. • Analyze and interpret data within the fossil record to determine similarities and differences in findings. • Make logical and conceptual connections between evidence in the fossil record and explanations about the existence, diversity, extinction, and change in many life forms throughout the history of life on Earth.

Unit Sequence	
Part B: *How do we know that birds and dinosaurs are related?*	
Concepts	**Formative Assessments**
• Similarities and differences exist in the gross anatomical structures of modern organisms. • There are anatomical similarities and differences among modern organisms and between modern organisms and fossil organisms. • Similarities and differences exist in the gross anatomical structures of modern organisms and their fossil relatives. • Similarities and differences in the gross anatomical structures of modern organisms enable the reconstruction of evolutionary history and the inference of lines of evolutionary decent.	*Students who understand the concepts can:* • Apply scientific ideas to construct explanations for evolutionary relationships. • Apply the patterns in gross anatomical structures among modern organisms and between modern organisms and fossil organisms to construct explanations of evolutionary relationships. • Apply scientific ideas about evolutionary history to construct an explanation for evolutionary relationships evidenced by similarities or differences in the gross appearance of anatomical structures.

• Patterns and anatomical similarities in the fossil record can be used to identify cause-and-effect relationships. • Science assumes that objects and events in evolutionary history occur in consistent patterns that are understandable through measurement and observation.	

Unit Sequence	
Part C: *Other than bones and structures being similar, what other evidence is there that birds and dinosaurs are related?*	
Concepts	**Formative Assessments**
• Relationships between embryos of different species show similarities in their development. • General patterns of relatedness among embryos of different organisms can be inferred by comparing the macroscopic appearance of diagrams or pictures. • Pictorial data can be used to identify patterns of similarities in embryological development across multiple species. • Similarities in embryological development across multiple species show relationships that are not evident in the fully formed organisms.	*Students who understand the concepts can:* • Use diagrams or pictures to identify patterns in embryological development across multiple species. • Analyze displays of pictorial data to identify where the embryological development is related linearly and where that linear nature ends. • Infer general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.

Connections to Other Units

Grade 6, Unit 4: 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.

Grade 7, Unit 5: Earth Systems

- 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.
- 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.

Appendix A: NGSS and Foundations for the Unit

Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. *[Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]* **(MS-LS4-1)**

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. *[Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]* **(MS-LS4-2)**

Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. *[Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]* **(MS-LS4-3)**

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 displays of data to identify linear and nonlinear relationships. (MS-LS4-3) • Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1) **Constructing Explanations and Designing Solutions** • Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2) --- **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)	**LS4.A: Evidence of Common Ancestry and Diversity** • The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) • Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) • Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)	**Patterns** • Patterns can be used to identify cause and effect relationships. (MS-LS4-2) • Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1),(MS-LS4-3) **Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6) --- - **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-LS4-1),(MS-LS4-2)

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-LS4-1),(MS-LS4-2),(MS-LS4-3) **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-LS4-1),(MS-LS4-3) **RST.6-8.7**	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-LS4-1),(MS-LS4-2) **6.EE.B.6**

Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3) **RST.6-8.9** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2) **WHST.6-8.2** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2) **WHST.6-8.9** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2) **SL.8.1** 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-LS4-2) **SL.8.4**	

Unit 2: Evidence of a Common Ancestry (15 days)			
This unit is based on:	**SLO**	**Inquiry Menu**	**Quick Links**
MS-L4-1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.	1. 2. Getting Into the Fossil Record What Do You Mean I Can Learn From a Fossil?	1. https://api.betterlesson.com/mtp/lesson/635205/print Link to above website: http://www.ucmp.berkeley.edu/education/explorations/tours/fossil/index.html 2. http://betterlesson.com/lesson/631865/what-do-you-mean-i-can-learn-from-a-fossil
MS-LS4-2	Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	3. 4. Evidence for Evolution - Fossil Record What Did T-Rex Taste Like?	3. http://betterlesson.com/lesson/638006/evidence-for-evolution-fossil-record 4. http://betterlesson.com/lesson/633888/what-did-t-rex-taste-like
MS-LS4-3	Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	5. Embryonic Development - Evidence for Evolution 6. *Classroom Explorations:* Zebrafish Development	5. http://betterlesson.com/lesson/637398/embryonic-development-evidence-for-evolution

			http://www.exploratorium.edu/imaging-station/activities/classroom/zebrafish_dev/ca_zebrafish_dev.php

1. This webquest takes students through various simulations which allows them to understand why some organisms become fossils, while others do not. It provides many examples (such as a mammoth, mouse, and jellyfish) and forces students to draw a comparison between them.
2. This website provides teachers with a short video clip which briefly describes the process of finding and unearthing a dinosaur fossil and two articles. The students read through the articles about fossil expeditions and take notes. At the end, students are to create an ad for an expedition into the Gobi Desert in which they describe the skills needed to be successful for this expedition.

This activity is a webquest which requires students to research various pieces of evidence during different time periods and record their

information in a chart. Students develop an understanding of how fossils can help paleontologists

3. learn more about a specific time era.
4. This is an online module created by the University of California in which students navigate through different folders and investigate cladograms and develop a better understanding of how cladograms show a common ancestry.
5. Students are given pictures of various organisms (such as a pig and chicken) and they complete a Venn Diagram of similarities and difference between two organisms. Students will notice that in the beginning the embryos look similar; however, develop their distinct features later in their embryonic stage. The similarities within organisms is an evidence of evolution.
6. Students observe the embryonic development of zebrafish through video clips and afterwards independently sequence their development. Many times students are not even aware of zebra fish; however, nowadays zebrafish are used to study human diseases due to their similar organ development and function.

Unit 3: 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.	*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.

• Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems.	

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.	**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)

	(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) **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)	***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)

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	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

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 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**	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) **6.SP.B.5**

Unit 3: 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. 2. 3. Cells to tissues to organs Ecosystem match up 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. 5. Going-Going-Gone 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. 7. Biotic and Abiotic Factors 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 4: 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. • 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	*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.

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) • Evaluate competing design solutions based	**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 shifts in all its populations. (MS-LS2-4)	**Stability and Change** • Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5) --- ***Connections to Engineering, Technology, and***

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)

- 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 evaluating solutions with respect to how well they meet the criteria and constraints

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)

	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 analysis of relevant content. (MS-LS2-2) **WHST.6-8.2** Integrate quantitative or technical information expressed in words in a	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**

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 4: 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. 2. Biodiversity DBQ 3. Sheep population graph 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 5: 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.	*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.

• 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 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.	*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.

• 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.	

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 phenomena. (MS-LS3-1),(MS-LS3-2)	**LS1.B: Growth and Development of Organisms** • Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)* **LS3.A: Inheritance of Traits** • Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) • Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits**	**Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

	• 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)	

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 5: Inheritance and Variation of Traits (20 days)			
This unit is	**SLO**	**STEM**	**Quick Links**

based on:			
MS-LS3-1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.	1. Mutations: How Gene Changes Can 2. Lead to Harmful, Beneficial, or Neutral Effects. 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-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. 4. Asexual reproduction 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 6: Selection and Adaptation

Unit Summary

Are Genetically Modified Organisms (GMO) safe to eat?

Students construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They will use ideas of genetic variation in a population to make sense of how organisms survive and reproduce, thus passing on the traits of the species. The crosscutting concepts of *patterns* and *structure and function* are called out as organizing concepts that students use to describe biological evolution. Students use the practices of *constructing explanations, obtaining, evaluating, and communicating information*, and *using mathematical and computational thinking*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

This unit is based on MS-LS4-4, MS-LS4-5, and MS-LS4-6.

Student Learning Objectives

Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. *[Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations]* **(MS-LS4-4)**

Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. *[Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]* **(MS-LS4-5)**

Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. *[Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]* **(MS-LS4-6)**

Unit Sequence

Part A: *How can changes to the genetic code increase or decrease an individual's chances of survival?*	
Concepts	**Formative Assessments**
• Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment. • Natural selection leads to the predominance of certain traits in a population and the suppression of others. • Natural selection may have more than one cause, and some cause-and-effect relationships within natural selection can only be described using probability.	*Students who understand the concepts can:* • Construct an explanation that includes probability statements regarding variables and proportional reasoning of how genetic variations of traits in a population increase some individuals' probability surviving and reproducing in a specific environment. • Use probability to describe some cause-and-effect relationships that can be used to explain why some individuals survive and reproduce in a specific environment.

Unit Sequence	
Part B: *How can the environment effect natural selection?*	
Concepts	**Formative Assessments**
• Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions. • The distribution of traits in a population changes. • Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. • Natural selection may have more than one cause, and some cause-and-effect relationships in natural selection can only be described using probability. • Mathematical representations can be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	*Students who understand the concepts can:* • Explain some causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time. • Use mathematical representations to support conclusions about how natural selection may lead to increases and decreases of genetic traits in populations over time.

Unit Sequence

Part C: *Are Genetically Modified Organisms (GMO) safe to eat?*	
Concepts	**Formative Assessments**
• In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. • In artificial selection, humans choose desirable, genetically determined traits in to pass on to offspring. • Phenomena, such as genetic outcomes in artificial selection, may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. • Technologies have changed the way humans influence the inheritance of desired traits in organisms. • Engineering advances have led to important discoveries in the field of selective breeding. • Engineering advances in the field of selective breeding have led to the development of entire industries and engineered systems. • Scientific discoveries have led to the development of entire industries and engineered systems.	*Students who understand the concepts can:* • Gather, read, and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) from multiple appropriate sources. • Describe how information from publications about technologies and methods that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) used are supported or not supported by evidence. • • Assess the credibility, accuracy, and possible bias of publications and they methods they used when gathering information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection).

Connections to Other Units

Grade 6: Unit 3: Interdependent Relationships in Ecosystems

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
- 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.

Grade 6, Unit 5: 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

- 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.

Appendix A: NGSS and Foundations for the Unit

Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. *[Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations]* **(MS-LS4-4)**

Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. *[Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]* **(MS-LS4-5)**

Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. *[Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]* **(MS-LS4-6)**

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 an explanation that includes qualitative or quantitative relationships between variables that describe	**LS4.B: Natural Selection** • Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) • In *artificial* selection, humans have the	**Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-

phenomena. (MS-LS4-4) **Obtaining, Evaluating, and Communicating Information** • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5) **Using Mathematics and Computational Thinking** • Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)	capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5) **LS4.C: Adaptation** • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	6) --- ***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-LS4-5) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

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-LS4-4),(MS-LS4-5) **RST.6-8.1** Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-4) **RST.6-8.9** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and	Model with mathematics. (MS-LS4-6) **MP.4** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4),(MS-LS4-6) **6.RP.A.1** Summarize numerical data sets in relation to their context. (MS-LS4-4),(MS-LS4-6) **6.SP.B.5** Recognize and represent proportional relationships between quantities. (MS-LS4-4),(MS-LS4-6) **7.RP.A.2**

analysis of relevant content. (MS-LS4-4) **WHST.6-8.2** Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5) **WHST.6-8.8** Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-4) **WHST.6-8.9** Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-4) **SL.8.1** 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-LS4-4) **SL.8.4**	

Unit 6: Selection and Adaptation (20 days)			
This unit is based on:	**SLO**	**Inquiry Menu**	**Quick Links**
MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	1. 2. Battle of the Beaks 99.99% Antibacterial Products And Natural Selection	1. http://www.ucmp.berkeley.edu/education/lessons/birdbeaks/birdbeaks.html 2. http://digital.nsta.org/article/99.99%25+ANTIBACTERIAL+PRODUCTS+AND+NATURAL+SELECTION/1562472/184198/article.html
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	3. 4. Peppered Moths Introduction of PBL: Is It the End of Humanity?	3. https://api.betterlesson.com/mtp/lesson/637464/print Link from above website: http://peppermoths.weebly.com/ 4. http://betterlesson.com/lesson/635476/introduction-of-pbl-is-it-the-end-of-humanity
MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	5. Pocket Mouse Example - Natural Selection 6. Evolution by Natural Selection	5. https://api.betterlesson.com/mtp/lesson/636021/print Video to go with above lesson: http://www.hhmi.org/biointeractive/making-fittest-natural-selection-and-

			adaptation 6. http://serendip.brynmawr.edu/sci_edu/waldron/pdf/NaturalSelectionTeachPrep.pdf

1. Students are asked to select one of the following items and have a seat: scissors, spoons, tweezers, and binder clip. Afterwards, the students are told that the item they selected represents their *beak* and they will be required to hunt for *food*. The teacher will place various items that represent food, such as paper clips, rubber bands, toothpicks, and uncooked macaroni. The student will then select the *food* which is best for his/her *beak*.
    a. This can lead to further discussions of *adaptation*, *extinction* and the *food chain*
2. Students are given a toothpick (represents hand sanitizer) and a plate full of Skittles and mini marshmallows (which represent bacteria). They are to *catch* as much bacteria with their toothpick in 7 seconds. The marshmallows will be easier to catch and the Skittles are harder showing that hand sanitizer kills 99.9% of the bacteria (marshmallows) and the .01% that it can't kill, is drug resistant bacteria. This illustrates to students that the *fittest* bacteria survived and multiplied in number while bacteria that was easy to kill is erased.
3. Students participate in an online simulation in which they tried to catch peppered moths in various backgrounds. During the industrial revolution the factories produced smog which resulted in *industrial melanism*. The white peppered moths were easier to spot on the darker buildings; thereby making them easier preys. This resulted in a shift in the peppered moth population.
4. Students are told that the world is going to end and there are only three ecosystems remaining: salt water oceans, expansive deserts and vast arctic regions. Their job is to research each ecosystem and identify what traits are favorable in their environments. Then the students will explain how humans can use genetic technology to ensure humanity survives.
5. This lesson comes with a brief video clip to introduce students to the variation of pocket mouse. The students are given sheets of paper with mouse drawings on them (The background color varies and some mice are more visible) The students count the mice, record their data on a chart, and later graph it to show an increase/decrease in a specific variation.
6. This activity requires teachers to setup two different environments (3 yards of faux fur and fleece) and lay out various colored pompoms. The students use a fork and spoon to put the pompoms in their cups which represents their stomach. The simulation continues throughout the period and students observe the population change across 3 generations. This requires students to obtain data and calculate the percent change of the population.