

PUBLIC SCHOOLS OF EDISON TOWNSHIP
OFFICE OF CURRICULUM AND INSTRUCTION



Science Grade 7

Length of Course:	Term
Elective/Required:	Required
Schools:	Middle Schools
Eligibility:	Grade 7
Credit Value:	N/A
Date Approved:	August 23, 2022

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Modifications will be made to accommodate IEP mandates for classified students

Statement of Purpose

In July 2011, the National Research Council (NRC) of the National Academy of Sciences developed [A Framework for K-12 Science Education](#). This guidance provides a sound, evidence-based foundation for standards by drawing on current scientific research - including research on the methods in which students learn science effectively and identifies the science all students in grade K-12 should know.

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

Dimension 1: Practices

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

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

Dimension 2: Cross Cutting Concepts

The Cross Cutting Concepts have application across all domains of science and, as such, are a way of linking different domains together. They include:

- Patterns, similarity, and diversity;
- Cause and effect;
- Scale, proportion, and quantity;
- Systems and system models;
- Energy and matter;
- Structure and function; and
- Stability and change.

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

Dimension 3: Disciplinary Core Ideas

Disciplinary Core Ideas have the power to focus K-12 science curriculum, instruction, and assessment on the most important aspects of science. To be considered core, the ideas meet at least two of the following criteria (and, ideally, all four):

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

Disciplinary Core Ideas are grouped in four domains: the [physical sciences](#), the [life sciences](#), the [earth and space sciences](#); and [engineering, technology, and applications of science](#).

Adopted by the State Board of Education in 2014, as the Next Generation Science Standards, they were renamed as the New Jersey Student Learning Standards for Science (NJLS-S) in May 2016.

The goal of the 7th grade Science curriculum is to produce students who have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives.

Students will be exposed to a “3D” approach to learning which intertwines the cross cutting concepts, scientific practices and disciplinary core ideas.

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Course Objectives

The student will be able to:

- NJSLS/MS-LS1-1: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
- NJSLS/MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
- NJSLS/MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
- NJSLS/MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
- NJSLS/MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
- NJSLS/MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- NJSLS/MS-LS1-7: Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
- NJSLS/MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- NJSLS/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.
- NJSLS/MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- NJSLS/MS-LS2-3: Develop a model to describe the cycling of matter and the flow of energy among living and nonliving parts of an ecosystem.
- NJSLS/MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- NJSLS/MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- NJSLS/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.
- NJSLS/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.
- NJSLS/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.
- NJSLS/MS-LS4-5: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
- NJSLS/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.

Timeline

First Marking Period Units:

Unit 1: Characteristics of Life

Unit 2: Structure, Function, Information Processing and Body Systems

Second Marking Period Units

Unit 3: Inheritance and Variation of Traits

Unit 4: Selection and Adaptation

Third Marking Period Units

Unit 5: Growth, Development and Reproduction of Organisms

Unit 6: Organization for Matter and Energy Flow in Organisms

Fourth Marking Period Units

Unit 7: Matter and Energy in Organisms and Ecosystems

Unit 8: Interdependent Relationships in Ecosystems

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Grade 7 Unit 1: Characteristics of Life

Approximate Instructional Days: 15

Unit Summary
<p>Essential Questions: What does it mean to be living? Students demonstrate age appropriate abilities to plan and carry out investigations to compare and contrast living (biotic) and non-living (abiotic) things. Students gather <i>evidence</i> to support explanations of what makes something living. They are able to communicate an understanding of the characteristics of living things. Students are expected to demonstrate proficiency in <i>engaging in argument from evidence</i> and <i>obtaining, evaluating, and communicating information</i>. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.</p>
Student Learning Objectives
<p>Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. <i>[Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]</i> MS-LS1-1</p>
Possible Student Misconceptions (based on research):
<p>Preliminary research indicates that it may be easier for students to understand that the cell is the basic unit of structure (which they can observe) than that the cell is the basic unit of function (which has to be inferred from experiments). Research also shows that high-school students may hold various misconceptions about cells after traditional instruction (NSDL, 2015).</p>
Unit Sequence
<p>Part A - Essential Question: <i>How will astrobiologists know if they have found life elsewhere in the solar system?</i></p>
Concepts/ Enduring Understanding
<ul style="list-style-type: none"> ● Identify the characteristics shared by all living things <ul style="list-style-type: none"> ○ Made of cells ○ Reproduce ○ Grow and develop ○ Use energy ○ Respond to surroundings ○ Made of chemicals of life (carbohydrates, proteins, lipids, nucleic acids) ● Distinguish between living (biotic) and non-living (abiotic) things based on the characteristics of life ● Cells are the smallest unit of life that can be said to be alive.

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Formative Assessment	
<p>Students who understand the concepts are able to:</p> <ul style="list-style-type: none"> ● Distinguish between living (biotic) and nonliving (abiotic) things. ● Conduct an investigation to produce data that provides evidence distinguishing between biotic and abiotic factors. 	
Recommended Activities/Assessments	
<ul style="list-style-type: none"> ● Introduction to CER ● CER lab-based lesson comparing and contrasting objects in order to classify as biotic or abiotic ● Introduce graphing ● District Unit 1 Common Assessment 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook - Structure of Life (Cells 1.2) 	<p>Savvas Workbook: Topic 1, Lesson 1 -Biotic and Abiotic, pages 5-9, 10-12 Savvas Workbook: Topic 5, Lesson 1, pages 254</p>
Common Core Standards Alignment	

ELA/Literacy	Mathematics	Technology	Career Ready Practice
<p>WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)</p> <p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2),(MS-LS1-7)</p>	<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-6)</p>	<p>8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results.</p>	<p>CRP2. Apply appropriate academic and technical skills.</p>

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<p style="text-align: center;">Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><u>Planning and Carrying Out Investigations</u></p> <p>Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)</p>	<p><u>LS1.A: Structure and Function</u></p> <p>All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)</p>	<p><u>Scale, Proportion, and Quantity</u></p> <p>Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)</p> <p>-----</p> <p>Connections to Engineering, Technology and Applications of Science Interdependence of Science, Engineering, and Technology Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)</p>

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Grade 7 Unit 2: Structure, Function, Information Processing and Body Systems

Approximate Instructional Days: 25

Unit Summary
<p>Essential Questions: How do cells contribute to the functioning of an organism?</p> <p>Students demonstrate age appropriate abilities to plan and carry out investigations to develop <i>evidence</i> that living organisms are made of cells. Students gather information to support explanations of the relationship between structure and function in cells. They are able to communicate an understanding of cell theory and understand that all organisms are made of cells. Students understand that special structures are responsible for particular functions in organisms. They then are able to use their understanding of cell theory to develop and use physical and conceptual models of cells. Students develop a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. Students will construct explanations for the interactions of systems in cells and organisms. Students understand that special structures are responsible for particular functions in organisms, and that for many organisms, the body is a system of multiple-interaction subsystems that form a hierarchy, from cells to the body. Students construct explanations for the interactions of systems in cells and organisms and how organisms gather and use information from the environment.</p> <p>The crosscutting concepts of <i>systems and system models; cause and effect, scale, proportion, and quantity; and structure and function</i> provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in <i>engaging in argument from evidence; obtaining, evaluation, and communicating information; planning and carrying out investigations, analyzing and interpreting data; and developing and using models</i>, Students are also expected to use these to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.</p>
Student Learning Objectives
<p>Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. <i>[Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.] MS-L21-2</i></p>
<p>Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. <i>[Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.] MS-LS1-3</i></p>
<p>Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. <i>[Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.] MS-LS1-8</i></p>
Possible Student Misconceptions (based on research):
<p>Preliminary research indicates that it may be easier for students to understand that the cell is the basic unit of structure (which they can observe) than that the cell is the basic unit of function (which has to be inferred from experiments). Research also shows that high-school students may hold various misconceptions about cells after traditional instruction (NSDL, 2015).</p>
Unit Sequence

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Part A - Essential Question: *How do the functions of cells support an entire organism?***Concepts/ Enduring Understanding**

- Cell Theory:
 - Cells come from other cells
 - All living things are made up of cells, either one cell or many different numbers and types of cells. Cells are the basic unit of structure and function in living things.
 - Organisms may consist of one single cell (unicellular) or organisms may consist of many different numbers and types of cells (multicellular).
- Engineering advances have led to important discoveries in the field of cell
 - Cells that can be observed at one scale may not be observable at another scale (microscopes).
 - Biology, and scientific discoveries have led to the development of entire industries and engineered systems.
- The cell is the basic unit of structure and function in an organism.
 - Within cells, special structures are responsible for particular functions.
 - Identify parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.
 - Complex and microscopic structures and systems in cells can be visualized, modeled, and used to describe how the function of the cell depends on the relationships among its parts.
 - A model can be used to describe how parts of cells contribute to the cell's function.
- Cells make an exact copy of DNA and organelles before reproduction.
 - Replication is necessary to make more cells because cells come from pre-existing cells.
 - Recognition of cell reproduction models.

Formative Assessment

Students who understand the concepts are able to:

Use an oral and written argument supported by evidence to support or refute an explanation or a model of how the cell is the basic unit of structure and function of an organism.

- Conduct an investigation to explain the components of cell theory
- Conduct an investigation to produce data supporting the concept that living things may be made of one cell or many and varied cells.
- Observe different types of cells that can be found in the makeup of living things.
- Develop and use a model to describe the function of a cell as a whole.
- Develop and use a model to describe how parts of cells contribute to the cell's function.
- Develop and use a model to show cell reproduction
- Observe cells at different intervals during the reproduction process

Recommended Activities/Assessments

- Cell theory lab/investigation/CER

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- Introduction to compound light microscope lab
- Introduction to scientific models
- Create a scientific model
- Cell part analogies
- Use the microscope to observe cell reproduction (e.g. onion root tip)
- District Unit 2 Common Assessment

Resources

- Discovery Education Techbook - Cell Theory (Cells 1.1) and Structure of Life (Cells 1.2)
 - Savvas Workbook: Topic 2, Lesson 1, Pages 62 - 70
 - Savvas Workbook: Topic 2, Lesson 2, Pages 73 - 80
 - Savvas Workbook: Topic 2, Lesson 4, Pages 92 - 96
 - Savvas Workbook: Topic 3, Lesson 1, Pages 131 - 133
 - Savvas Workbook: Appendix C, Pages 488-489

Unit Sequence

Part B - Essential Question: *What is the evidence that a body is actually a system of interacting subsystems composed of groups of interacting cells?*

Concepts/ Enduring Understanding

- In multicellular organisms, the body is a system of multiple, interacting subsystems organized into levels.
 - The basic unit is a cell.
 - Specialized groups of cells work together to form tissues.
 - Organs are groups of tissues that work together to perform a particular body function.
 - Organ systems are groups of organs working together to perform a specific function.
- Systems may interact with other systems.
- Interactions are limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.
- Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas.

Formative Assessment

Students who understand the concepts are able to:

Use an oral and written argument supported by evidence to support or refute an explanation or a model of how the body is a system of interacting subsystems composed of groups of cells.

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- Create a model showing the levels of organization from cell to organism
- Use evidence to show how one system affects/impacts other systems
- Create a model of systems showing the interacting contributing the function of the whole organism

Recommended Activities/Assessments

- Levels of organization activity
- Students will pick one body system, research, and create a model demonstrating the steps in their system and its relation/connection to other systems within the organism
 - gallery walk or presentations, critique models
- District Unit 2 Common Assessment
- District MP1 Benchmark Assessment

Resources

- Discovery Education Techbook - Human Systems (Unit 3)
 - Savvas Workbook: Topic 3, Lesson 1, Pages 130 - 137
 - Savvas Workbook: Topic 3, Lesson 2, Pages 140 - 148
 - Savvas Workbook, Topic 3, Lesson 3, Pages 152 - 161
 - Savvas Workbook: Topic 3, Lesson 4, Pages 164 - 173
 - Savvas Workbook: Topic 3, Lesson 5, Pages 176 - 184

Part C - Essential Question: *How do organisms receive and respond to information from their environment?*

Concepts/ Enduring Understanding

- Sense receptors respond to different inputs (electromagnetic, mechanical, chemical).
- Sense receptors transmit responses as signals that travel along nerve cells to the brain.
- Signals are then processed in the brain.
- Brain processing results in immediate behaviors or memories.
- Cause-and-effect relationships may be used to predict response to stimuli in natural systems.

Recommended Activities/Assessments

- Lab-based activity responding to stimuli

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Resources	
<ul style="list-style-type: none"> Discovery Education Techbook - Human Systems (Unit 3) 	Savvas Workbook: Topic 3, Lesson 5, Pages 176 - 184
Common Core Standards Alignment	

ELA/Literacy	Mathematics	Technology	Career Ready Practice
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6)</p> <p>RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3),(MS-LS1-4)</p> <p>WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-3),(MS-LS1-4)</p> <p>WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS1-8)</p>	<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-6)</p>	<p>8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results.</p>	<p>CRP4. Communicate clearly and effectively and with reason</p>
<p>Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>			
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts	

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<p>Obtaining, Evaluating, and Communicating Information</p> <p>Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)</p> <p>Engaging in Argument from Evidence</p> <p>Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)</p> <p>Developing and Using Models</p> <p>Develop a model to describe phenomena. (MS-LS1-2)</p>	<p>LS1.A: Structure and Function</p> <p>Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)</p> <p>In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)</p> <p>LS1.D: Information Processing</p> <p>Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)</p>	<p>Systems and System Models</p> <p>Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)</p> <p>Cause and Effect</p> <p>Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)</p> <p>Structure and Function</p> <p>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)</p> <p>-----</p> <p><i>Connections to Nature of Science</i></p> <p>Science is a Human Endeavor</p> <p>Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)</p>
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Grade 7 Unit 3: Inheritance and Variation of Traits

Approximate Instructional Days: 20

Unit Summary
<p>Essential Questions: What are humans made of?</p> <p>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 <i>cause and effect</i> and <i>structure and function</i> provide a framework for understanding how gene structure determines differences in the functioning of organisms.</p> <p>Students are expected to demonstrate proficiency in <i>developing and using models</i>. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.</p>
Student Learning Objectives
<p>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 on the structure and function of the organism. <i>[Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.]</i> <i>[Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]</i> (MS-LS3-1)</p>
<p>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. <i>[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.]</i> (MS-LS3-2)</p>
Possible Student Misconceptions (based on research):
<p>Students of all ages see food as substances (water, air, minerals, etc.) that organisms take directly from their environment. In addition, some students of all ages think food is a requirement for growth, rather than a source of matter for growth. They have little knowledge about food being transformed and made part of a growing organism's body.</p> <p>Some students of all ages hold misconceptions about plant nutrition. They think plants get their food from the environment rather than manufacturing it internally, and that food for plants is taken in from the outside. These misconceptions are particularly resistant to change. Even after traditional instruction, students have difficulty accepting that plants make food from water and air, and that this is their only source of food. Understanding that the food made by plants is very different from other nutrients such as water or minerals is a prerequisite for understanding the distinction between plants as producers and animals as consumers (NSDL, 2015).</p>
Unit Sequence
<p>Part A - Essential Question: How do structural changes to genes (mutations) located on chromosomes affect the structure and function of an organism?</p>
Concepts/ Enduring Understanding
<ul style="list-style-type: none"> ● Complex and microscopic structures and systems, such as genes located on chromosomes, can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among the parts of the system; therefore, complex natural structures/systems can be analyzed to determine how they function. ● Genes, comprised of DNA, are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes.

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- All life is based on the genetic code contained in DNA, and variation in the genetic code leads to diversity of life.
- 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 are harmful, and some are neutral to the organism.

Formative Assessment

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 result in harmful, beneficial, or neutral effects to the structure and function of the organism.

Recommended Activities/Assessments

- Create and read Punnett squares
- Pedigree practice
- Vocabulary review and reinforce
 - gene, allele, dominant, recessive, genotype, phenotype, purebred, hybrid, homozygous, heterozygous, probability
- Analyzing bar graphs do-now questions
- Karyotyping to show genetic disorders/chromosomal abnormalities
- Case studies of different mutation examples
 - beneficial, harmful, neutral

Resources

Discovery Education TechBook - Mendel and Heredity (Unit 3:2.5)
Genes and the Impacts of Mutations on Organisms (Cells 1.6)

Savvas Workbook: Topic 4, lesson 1, pages 198-206,
Savvas Workbook: Topic 7, lesson 1, pages 345-356
Savvas Workbook: Topic 7, lesson 2, pages 361-367
Savvas Workbook: Topic 7, lesson 4, pages 384-391

Part B - Essential Question: *How do asexual reproduction and sexual reproduction affect the genetic variation of offspring?*

Concepts/ Enduring Understanding

- 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.

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<ul style="list-style-type: none"> ● 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.
Formative Assessment
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● 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.
Recommended Activities/Assessments
<ul style="list-style-type: none"> ● Discovery Techbook - Explore, Engage, Explain, and Evaluate <ul style="list-style-type: none"> ○ Extension - Elaborate with STEM ● District Unit 3 Common Assessment
Resources
<ul style="list-style-type: none"> ● Discovery Education Techbook - Unit 3, Asexual Reproduction (2.3), Sexual Reproduction (2.4) Savvas Workbook: Topic 4, lesson 1 pages 199-206
Common Core Standards Alignment

ELA/Literacy	Mathematics	Technology	Career Ready Practice
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1),(MS-LS3-2) RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. (MS-LS3-1),(MS-LS3-2) RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)	MP.4 Model with mathematics. (MS-LS3-2) 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS3-2)	8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results.	CRP4. Communicate clearly and effectively and with reason

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<p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS3-1),(MS-LS3-2)</p>			
<p>Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>			
<p>Science and Engineering Practices</p>	<p>Disciplinary Core Ideas</p>	<p>Crosscutting Concepts</p>	
<p>Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)</p>	<p>LS1.B: Growth and Development of Organisms Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary to MS- LS3-2) LS3.A: Inheritance of Traits Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) LS3.B: Variation of Traits In sexually reproducing organisms, each parent contributes half of the genes 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)</p>	<p>Cause and Effect Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) 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)</p>	

Grade 7 Unit 4: Selection and Adaptation

Approximate Instructional Days: 20

Unit Summary
<p>Essential Questions: Are Genetically modified organisms (GMO) safe to eat?</p> <p>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 <i>patterns</i> and <i>structure and function</i> are called out as organizing concepts that students use to describe biological evolution.</p> <p>Students use the practices of <i>constructing explanations, obtaining, evaluating, and communicating information, and using mathematical and computational thinking</i>. Students are also expected to use these practices to demonstrate an understanding of the core ideas.</p>
Student Learning Objectives
<p>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. <i>[Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations]</i> (MS-LS4-4)</p>
<p>Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. <i>[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.]</i> (MS-LS4-5)</p>
<p>Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. <i>[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.]</i> (MS-LS4-6)</p>
Possible Student Misconceptions (based on research):
<p>Students, even after some years of biology instruction, have difficulties understanding the notion of natural selection. A major hindrance to understanding natural selection appears to be students' inability to integrate two distinct processes in evolution, the occurrence of new traits in a population and their effect on long-term survival. Many students believe that environmental conditions are responsible for changes in traits, or that organisms develop new traits because they need them to survive, or that they overuse or under-use certain bodily organs or abilities. By contrast, students have little understanding that chance alone produces new heritable characteristics by forming new combinations of existing genes or by mutations of genes. Some students believe that a mutation modifies an individual's own form during its life rather than only its germ cells and offspring (see almost any science fiction movie). Students also have difficulties understanding that changing a population results from the survival of a few individuals that preferentially reproduce, not from the gradual change of all individuals in the population. Explanations about "insects or germs becoming more resistant" rather than "more insects or germs becoming resistant" may reinforce these misunderstandings. Specially designed instruction can improve students' understanding of natural selection.</p> <p>Students may have difficulties with the various uses of the word "adaptation". In everyday usage, individuals adapt deliberately. But in the theory of natural selection, populations change or "adapt" over generations, inadvertently. Students of all ages often believe that adaptations result from some overall purpose or design, or they describe adaptation as a conscious process to fulfill some need or want. Elementary- and middle-school students also tend to confuse non-inherited adaptations acquired during an individual's lifetime with adaptive features that are inherited in a population (NSDL, 2015)</p>

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Unit Sequence	
Part A - Essential Question: <i>How can changes to the genetic code increase or decrease an individual's chances of survival?</i>	
Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● 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 	
Formative Assessment	
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● 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. 	
Recommended Activities/Assessments	
<ul style="list-style-type: none"> ● Analyze real-world examples of adaptations ● Create an organism, based on specific environmental criteria, that is uniquely adapted to its habitat 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook - Evolution, Adaptations Unit 4 (4.3) 	Savvas Workbook: Topic 8, Lesson 2, pages 426-431 Savvas Workbook: Topic 8, Lesson 3, pages 435-440
Part B - Essential Question: <i>How can the environment affect natural selection?</i>	
Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● 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. 	

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Formative Assessment	
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● 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. 	
Recommended Activities/Assessments	
<ul style="list-style-type: none"> ● Lamarck vs. Darwin giraffe activity ● Rock Pocket Mouse Activity ● Bird Beak Activity ● District Unit 4 Common Assessment 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook - Darwin and Natural Selection Unit 4 (4.4) 	Savvas Workbook: Topic 8, Lesson 1, pages 415 - 422 Savvas Workbook: Topic 8, Lesson 2, pages 425 - 431
<p>Part C – Essential Question: <i>Are Genetically Modified Organisms (GMO) safe to eat?</i></p>	
Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. ● In artificial selection, humans choose desirable, genetically determined traits to pass on to offspring. ● 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. 	
Formative Assessment	
<p><i>Students who understand the concepts can:</i></p> <ul style="list-style-type: none"> ● 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. 	

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<ul style="list-style-type: none"> 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).
Recommended Activities/Assessments
<ul style="list-style-type: none"> Analyze real-world examples of artificial selection (selective breeding) <ul style="list-style-type: none"> dog breeds, fruits and vegetables, etc. District MP 2 Benchmark Assessment
Resources
<ul style="list-style-type: none"> Discovery Education Techbook - Influencing Inheritance Unit 2 (2.2) Savvas Workbook: Topic 7, Lesson 5, pages 393-400
Common Core Standards Alignment

ELA/Literacy	Mathematics	Technology	Career Ready Practice
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-LS4-1),(MS-LS4-2),(MS-LS4-3),(MS-LS4-4)(MS-LS4-5)</p> <p>RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3),(MS-LS4-4)</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2),(MS-LS4-4)</p> <p>WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2),(MS-LS4-4)</p> <p>SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on</p>	<p>MP.4 Model with mathematics. (MS-LS4-6)</p> <p>6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4),(MS-LS4-6)</p> <p>6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS4-4),(MS-LS4-6)</p> <p>7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-LS4-4),(MS-LS4-6)</p>	<p>8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools</p>	<p>CRP4. Communicate clearly and effectively and with reason</p>

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<p>grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2),(MS-LS4-4) SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS4-2),(MS-LS4-4)</p>			
<p>Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>			
<p>Science and Engineering Practices</p>	<p>Disciplinary Core Ideas</p>	<p>Crosscutting Concepts</p>	
<p><u>Constructing Explanations and Designing Solutions</u> <u>Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)</u></p> <p><u>Obtaining, Evaluating, and Communicating Information</u> <u>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)</u></p> <p><u>Using Mathematics and Computational Thinking</u> <u>Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)</u></p>	<p><u>LS4.B: Natural Selection</u> <u>Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)</u> <u>In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)</u></p> <p><u>LS4.C: Adaptation</u> <u>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)</u></p>	<p><u>Cause and Effect</u> <u>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)</u></p> <p>-----</p> <p><i>Connections to Engineering, Technology, and Applications of Science</i></p> <p><u>Interdependence of Science, Engineering, and Technology</u> <u>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)</u></p> <p>-----</p> <p><i>Connections to Nature of Science</i></p> <p>Science Addresses Questions About the Natural and Material World</p> <p>Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)</p>	

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Grade 7 Unit 5: Growth, Development and Reproduction of Organisms

Approximate Instructional Days: 25

Unit Summary
<p>Essential Questions: What influences the growth and development of an organism?</p> <p>Students use data and conceptual models to understand how the environment and genetic factors determine the growth of an individual organism. They connect this idea to the role of animal behaviors in animal reproduction and to the dependence of some plants on animal behaviors for their reproduction. Students provide evidence to support their understanding of the structures and behaviors that increase the likelihood of successful reproduction by organisms. The crosscutting concepts of <i>cause and effect</i> and <i>structure and function</i> provide a framework for understanding the disciplinary core ideas.</p> <p>Students demonstrate grade-appropriate proficiency in <i>analyzing and interpreting data, using models, conducting investigations, and communicating information</i>. Students are also expected to use these practices to demonstrate an understanding of the core ideas.</p>
Student Learning Objectives
<p>Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. <i>[Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]</i> (MS-LS1-4)</p>
<p>Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. <i>[Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]</i> <i>[Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]</i> (MS-LS1-5)</p>
Possible Student Misconceptions (based on research):
<p>Students may not believe food is a scarce resource in ecosystems, thinking that organisms can change their food at will, according to the availability of particular sources. Students of all ages think that some populations of organisms are numerous in order to fulfill a demand for food by another population.</p> <p>Students may believe that organisms are able to affect changes in bodily structure to exploit particular habitats or that they respond to a changed environment by seeking a more favorable environment. It has been suggested that the language about adaptation used by teachers or textbooks to make biology more accessible to students may cause or reinforce these beliefs (NSDL, 2015).</p>
Unit Sequence
<p>Part A - Essential Question: <i>How do characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively?</i></p>

Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. <ul style="list-style-type: none"> ○ Plants contain specialized structures for reproduction ○ Pollination ○ Seed dispersal ● Specialized structures for plants affect their probability of successful reproduction. ● Some characteristic animal behaviors affect the probability of successful reproduction in plants. ● Animals engage in characteristic behaviors that affect the probability of successful reproduction. ● There are a variety of characteristic animal behaviors that affect their probability of successful reproduction. ● There are a variety of animal behaviors that attract a mate. ● Successful reproduction of animals and plants may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. 	
Formative Assessment	
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● Collect empirical evidence about animal behaviors that affect the animals' probability of successful reproduction and also affect the probability of plant reproduction. ● Collect empirical evidence about plant structures that are specialized for reproductive success. ● Use empirical evidence from experiments and other scientific reasoning to support oral and written arguments that explain the relationship among plant structure, animal behavior, and the reproductive success of plants. ● Identify and describe possible cause-and effect relationships affecting the reproductive success of plants and animals using probability. ● Support or refute an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful plant reproduction using oral and written arguments. 	
Recommended Activities/Assessments	
<ul style="list-style-type: none"> ● Lab identifying different methods of plant reproduction ● Lab observing and collecting data on animal behavior, such as create ethogram (live crickets, live cam footage of animals, etc.) ● District Unit 5 Common Assessment 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook- Diversity of Life, Plants (5.1) 	Savvas Workbook: Topic 4, Lesson 2, Pages 208 - 209, 212 - 215 Savvas Workbook: Topic 4, Lesson 3, Pages 218 - 225
<p>Part B - Essential Question: <i>How do environmental and genetic factors influence the growth of organisms?</i></p>	

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Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● Genetic factors as well as local conditions affect the growth of organisms. <ul style="list-style-type: none"> ○ A variety of local environmental conditions affect the growth of organisms. ● Genetic factors affect the growth of organisms (plant and animal). ● The factors that influence the growth of organisms may have more than one cause. ● Some cause-and-effect relationships in plant and animal systems can only be described using probability. 	
Formative Assessment	
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● Conduct experiments, collect evidence, and analyze empirical data. ● Use evidence from experiments and other scientific reasoning to support oral and written explanations of how environmental and genetic factors influence the growth of organisms. ● Identify and describe possible causes and effects of local environmental conditions on the growth of organisms. ● Identify and describe possible causes and effects of genetic conditions on the growth of organisms. 	
Recommended Activities/Assessments	
<ul style="list-style-type: none"> ● Collect data in order to create graphs of plants that in different areas/conditions; students determine what allows them to survive <ul style="list-style-type: none"> ○ Students will show their findings through CER report 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook - Diversity of Life, Plants (5.1) Savvas Workbook: Topic 4, Lesson 4, Pages 228 - 236 	
Common Core Standards Alignment	

ELA/Literacy	Mathematics	Technology	Career Ready Practice
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6) RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5),(MS-LS1-6) RI.6.8	6.SPA.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4),(MS-LS1-5) 6.SP.B.4 Summarize numerical data sets in relation to their context. (MS-LS1-4),(MS-LS1-5)	8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools	CRP4. Communicate clearly and effectively and with reason

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<p>Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3),(MS-LS1-4) WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-3),(MS-LS1-4) WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5),(MS-LS1-6) WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5),(MS-LS1-6)</p>			
<p>Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>			
<p>Science and Engineering Practices</p>	<p>Disciplinary Core Ideas</p>	<p>Crosscutting Concepts</p>	
<p><u>Engaging in Argument from Evidence</u> <u>Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4)</u></p> <p><u>Constructing Explanations and Designing Solutions</u> <u>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5)</u></p>	<p><u>LS1.B: Growth and Development of Organisms</u> <u>Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)</u> <u>Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)</u> <u>Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)</u></p>	<p><u>Cause and Effect</u> <u>Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-4),(MS-LS1-5)</u> <u>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5)</u></p> <p><u>Structure and Function</u> <u>Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-4), (MS-LS1-5)</u></p>	

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Grade 7 Unit 6: Organization for Matter and Energy Flow in Organisms

Approximate Instructional Days: 15

Unit Summary
<p>Essential Questions: How do some organisms turn electromagnetic radiation into matter and energy?</p> <p>Students provide a mechanistic account for how cells provide a structure for the plant process of photosynthesis in the movement of matter and energy needed for the cell. Students use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They construct scientific explanations for the cycling of matter in organisms and the interactions of organisms to obtain matter and energy from an ecosystem to survive and grow. They understand that sustaining life requires substantial energy and matter inputs, and that the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy.</p> <p>The crosscutting concepts of <i>matter and energy</i> and <i>structure and function</i> provide a framework for understanding of the cycling of matter and energy flow into and out of organisms. Students are also expected to demonstrate proficiency in <i>developing and using models</i>. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.</p>
Student Learning Objectives
<p>Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.] (MS-LS1-6)</p>
<p>Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.] (MS-LS1-7)</p>
Possible Student Misconceptions (based on research):
<p>Students of all ages see food as substances (water, air, minerals, etc.) that organisms take directly in from their environment. In addition, some students of all ages think food is a requirement for growth, rather than a source of matter for growth. They have little knowledge about food being transformed and made part of a growing organism's body.</p> <p>Some students of all ages hold misconceptions about plant nutrition. They think plants get their food from the environment rather than manufacturing it internally, and that food for plants is taken in from the outside. These misconceptions are particularly resistant to change. Even after traditional instruction, students have difficulty accepting that plants make food from water and air, and that this is their only source of food. Understanding that the food made by plants is very different from other nutrients such as water or minerals is a prerequisite for understanding the distinction between plants as producers and animals as consumers (NSDL, 2015).</p>
Unit Sequence
<p>Part A - Essential Question: <i>What is the role of photosynthesis in the cycling of matter and flow of energy into and out of an organism?</i></p>
Concepts/ Enduring Understanding
<ul style="list-style-type: none"> ● Photosynthesis has a role in the cycling of matter and flow of energy into and out of organisms.

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- The flow of energy and cycling of matter can be traced.
- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon based organic molecules and release oxygen.
- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen.
- Sugars produced by plants can be used immediately or stored for growth or later use.
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

Formative Assessment

Students who understand the concepts are able to:

- Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on valid and reliable evidence obtained from sources (including the students' own experiments)
- Construct a scientific explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms based on the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Recommended Activities/Assessments

Create a model of photosynthesis
District Unit 6 Common Assessment

Student create explanation of the role of photosynthesis using evidence from lab activities

Resources

- Discovery Education Techbook, Cells (1.5)
- Savvas Workbook: Topic 2, Lesson 5, Pages 98 - 105

Part B - Essential Question: *How is food rearranged through chemical reactions to form new molecules that support growth and/or release energy as this matter moves through an organism?*

Concepts/ Enduring Understanding

- Food is rearranged through chemical reactions, forming new molecules that support growth.
- Food is rearranged through chemical reactions, forming new molecules that release energy as this matter moves through an organism.
- Molecules are broken apart and put back together to form new substances, and in this process, energy is released.
- Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy.
- In cellular respiration, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials.
- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules to support growth or to release energy.
- Matter is conserved during cellular respiration because atoms are conserved in physical and chemical processes.

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Formative Assessment	
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● Develop and use a model to describe how food is rearranged through chemical reactions. 	
Recommended Activities/ Assessments	
<ul style="list-style-type: none"> ● Create a model of cellular respiration ● Optional: create a model of the interaction between photosynthesis and cellular respiration ● District MP 3 Benchmark Assessment 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook Cells, Respiration (1.3) 	<p>Savvas Workbook: Topic 2, Lesson 6, Pages 108 - 113</p>
Common Core Standards Alignment	

ELA/Literacy	Mathematics	Technology	Career Ready Practice
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6)</p> <p>RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5),(MS-LS1-6)</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5),(MS-LS1-6)</p> <p>WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5),(MS-LS1-6)</p> <p>SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2),(MS-LS1-7)</p>	<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-6)</p>	<p>8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools</p>	<p>CRP4. Communicate clearly and effectively and with reason</p>
<p>Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>			

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Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p><u>Constructing Explanations and Designing Solutions</u></p> <p><u>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-6)</u></p> <p><u>Developing and Using Models</u></p> <p>Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-7)</p>	<p><u>LS1.C: Organization for Matter and Energy Flow in Organisms</u></p> <p><u>Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)</u></p> <p><u>Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)</u></p> <p><u>PS3.D: Energy in Chemical Processes and Everyday Life</u></p> <p><u>The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6)</u></p> <p><u>Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)</u></p>	<p><u>Energy and Matter</u></p> <p><u>Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)</u></p> <p><u>Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)</u></p> <p>-----</p> <p><i>Connections to Nature of Science</i></p> <p>Scientific Knowledge is Based on Empirical Evidence</p> <p>Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)</p>

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Grade 7 Unit 7: Matter and Energy in Ecosystems and Organisms

Approximate Instructional Days: 20

Unit Summary
<p>Essential Questions: How and why do organisms interact with their environment and what are the effects of these interactions? <i>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 cross cutting concepts of <i>matter and energy, systems and system models, patterns and cause and effect</i> provide a framework for understanding the disciplinary core ideas.</i></p> <p>Students demonstrate grade-appropriate proficiency in <i>analyzing and interpreting data, developing models, and constructing arguments</i>. Students are also expected to use these practices to demonstrate an understanding of the core ideas.</p>
Student Learning Objectives
<p>Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. <i>[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.]</i> (MS-LS2-1)</p>
<p>Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. <i>[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.]</i> (MS-LS2-2)</p>
<p>Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. <i>[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.]</i> <i>[Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]</i> (MS-LS2-3)</p>
Possible Student Misconceptions (based on research):
<p>Some students have difficulty in identifying the sources of energy for plants and also for animals. Students tend to confuse energy and other concepts such as food, force, and temperature. As a result, students may not appreciate the uniqueness and importance of energy conversion processes like respiration and photosynthesis. Although specially designed instruction does help students correct their understanding about energy exchanges, some difficulties remain. Careful coordination between the Physical and Life Sciences Disciplinary Core Ideas about conservation of matter and energy and the nature of energy may help alleviate these difficulties.</p> <p>Students of all ages see food as substances (water, air, minerals, etc.) that organisms take directly from their environment. In addition, some students of all ages think food is a requirement for growth, rather than a source of matter for growth. They have little knowledge about food being transformed and made part of a growing organism's body.</p> <p>Some students of all ages hold misconceptions about plant nutrition. They think plants get their food from the environment rather than manufacturing it internally, and that food for plants is taken in from the outside. These misconceptions are particularly resistant to change. Even after traditional instruction, students have difficulty accepting that plants make food from water and air, and that this is their only source of food. Understanding that the food made by plants is very different from other nutrients such as water or minerals is a prerequisite for understanding the distinction between plants as producers and animals as consumers.</p>

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Some middle-school students do not realize that the matter from dead organisms is converted into other materials in the environment. Some middle-school students see decay as a gradual, inevitable consequence of time without need of decomposing agents. Some high-school students believe that matter is conserved during decay, but do not know where it goes.

Middle-school students seem to know that some kind of cyclical process takes place in ecosystems. Some students see only chains of events and pay little attention to the matter involved in processes such as plant growth or animals eating plants. They think the processes involve creating and destroying matter rather than transforming it from one substance to another. Other students recognize one form of recycling through soil minerals but fail to incorporate water, oxygen, and carbon dioxide into matter cycles. Even after specially designed instruction, students cling to their misinterpretations. Instruction that traces matter through the ecosystem as a basic pattern of thinking may help correct these difficulties ([NSDL, 2015](#)).

Unit Sequence

Part A - Essential Question: *How do changes in the availability of matter and energy affect populations in an ecosystem?*

Concepts/ Enduring Understanding

- 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

Formative Assessment

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.

Recommended Activities/Assessments

- Ecological Survey of Edison (identify biotic and abiotic factors, competition, etc. within the area)
- Analyze graphs showing how organisms/populations change in varying environmental conditions

Resources

Discovery Education Techbook Ecology, Biotic and Abiotic Factors (6.2)
 Discovery Education Techbook Ecology, Energy in Ecosystems (6.1)

Savvas Workbook: Topic 5, Lesson 1, Pages 252 - 258
 Savvas Workbook: Topic 6, Lesson 1, Pages 294 - 302

Part B - Essential Question: *How do relationships among organisms in an ecosystem affect populations?*

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Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. ● Mutually beneficial interactions may become so interdependent that each organism requires the other for survival. ● The patterns of interactions of organisms with their environment, both its living and nonliving components, are shared. ● Interactions within ecosystems have patterns that can be used to identify cause-and-effect relationships. ● Patterns of interactions among organisms across multiple ecosystems can be predicted. ● Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems. 	
Formative Assessment	
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> ● 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. 	
Recommended Activities/Assessments	
<ul style="list-style-type: none"> ● Ecological Survey of Edison (identify relationships of organisms found within the area) ● Create models showing real-world examples of each type of interaction 	
Resources	
<ul style="list-style-type: none"> ● Discovery Education Techbook- Relationships Among Organisms (7.1) 	Savvas Workbook: Topic 6, Lesson 1, Pages 294 - 302
Part C - Essential Question: <i>How can you explain the stability of an ecosystem by tracing the flow of matter and energy?</i>	
Concepts/ Enduring Understanding	
<ul style="list-style-type: none"> ● 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. 	

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<ul style="list-style-type: none"> Science assumes that objects and events in ecosystems occur in consistent patterns that are understandable through measurement and observation.
Formative Assessment
<p><i>Students who understand the concepts are able to:</i></p> <ul style="list-style-type: none"> 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 the ecosystem. Track the transfer of energy as energy flows through an ecosystem. Observe and measure patterns of objects and events in ecosystems.
Recommended Activities/Assessments
<ul style="list-style-type: none"> Ecological Survey of Edison (identify organisms of different energy roles) Create a model to show the movement of energy through a food web in specific ecosystem District Unit 7 Common Assessment
Resources
<ul style="list-style-type: none"> Discovery Education Techbook- Relationships Among Organisms (7.1) Savvas Workbook: Topic 5, Lesson 2, Pages 262 - 269
Common Core Standards Alignment

ELA/Literacy	Mathematics	Technology	Career Ready Practice
<p>RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2),(MS-LS2-4)</p> <p>RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)</p> <p>WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant</p>	<p>6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS2-3)</p> <p>6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS2-2)</p>	<p>8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools</p>	<p>CRP4. Communicate clearly and effectively and with reason</p>

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<p>content. (MS-LS2-2) WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2),(MS-LS2-4) SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS2-2) SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2) SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS2-3)</p>			
<p>Next Generation Science Standards and Foundations for the Unit The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:</p>			
<p>Science and Engineering Practices</p>	<p>Disciplinary Core Ideas</p>	<p>Crosscutting Concepts</p>	

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<p>Analyzing and Interpreting Data</p> <p><u>Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)</u></p> <p>Constructing Explanations and Designing Solutions</p> <p><u>Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)</u></p> <p>Developing and Using Models</p> <p><u>Develop a model to describe phenomena. (MS-LS2-3)</u></p>	<p>LS2.A: Interdependent Relationships in Ecosystems</p> <p><u>Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)</u></p> <p><u>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)</u></p> <p><u>Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)</u></p> <p><u>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)</u></p> <p>LS2.B: Cycle of Matter and Energy Transfer in Ecosystems</p> <p><u>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)</u></p>	<p>Patterns</p> <p><u>Patterns can be used to identify cause and effect relationships. (MS-LS2-2)</u></p> <p>Cause and Effect</p> <p><u>Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)</u></p> <p>Energy and Matter</p> <p><u>The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)</u></p> <p>-----</p> <p>Connections to Nature of Science</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <p>Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation (MS-LS2-3)</p>
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Grade 7 Unit 8: Interdependent Relationships in Ecosystems

Approximate Instructional Days: 20

Unit Summary
<p>Essential Questions: What happens to ecosystems when the environment changes?</p> <p>Students build on their understanding 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</p> <p>Students demonstrate grade-appropriate proficiency in <i>analyzing and interpreting data</i>, <i>developing models</i>, and <i>constructing arguments</i>. Students are also expected to use these practices to demonstrate an understanding of the core ideas.</p>
Student Learning Objectives
<p>Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. <i>[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.]</i> (MS-LS2-4)</p>
<p>Evaluate competing design solutions for maintaining biodiversity and ecosystem services. * <i>[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.]</i> (MS-LS2-5)</p>
Possible Student Misconceptions (based on research):
<p>Students may believe that organisms are able to affect changes in bodily structure to exploit particular habitats or that they respond to a changed environment by seeking a more favorable environment. It has been suggested that the language about adaptation used by teachers or textbooks to make biology more accessible to students may cause or reinforce these beliefs.</p> <p>Some students think dead organisms simply rot away. They do not realize that the matter from the dead organism is converted into other materials in the environment. Some students see decay as a gradual, inevitable consequence of time without need of decomposing agents. Some students believe that matter is conserved during decay, but do not know where it goes (NSDL 2015).</p>
Unit Sequence
<p>Part A - Essential Question: How can a single change to an ecosystem disrupt the whole system?</p>
Concepts/ Enduring Understanding
<ul style="list-style-type: none"> • Ecosystems are dynamic in nature. • The characteristics of ecosystems can vary over time. • Disruptions to any physical or biological components 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.

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- 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.

Formative Assessment

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.

Recommended Activities/Assessments

- [Wolves of Yellowstone](#) Case Study (observations, data, analysis)
- [Ecology Disrupted](#) (observations, data, analysis)
- [Benefit of large biodiversity card activity](#)

Resources

- Discovery Education Techbook-Environmental Issues, Endangered Species (8.3) Savvas Workbook: Topic 6, Lesson 2, Pages 304 - 308
Savvas Workbook: Topic 6, Lesson 3, Pages 312 - 332

Part B - Essential Question: *What limits the number and variety of living things in an ecosystem?*

Concepts/ Enduring Understanding

- 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.

Formative Assessment

Students who understand the concepts are able to:

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- 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.

Recommended Activities/Assessments

- Research-based project on a case study of specific ecosystem and its changes
 - incorporate mini lessons about research, credible sources, works cited
- Discovery Education Techbook- STEM activity (8.3)
- District Unit 8 Common Assessment

Resources

- Discovery Education Techbook, Environmental Issues, Preventing Land Use and Environmental Problems (8.3) Savvas Workbook: Topic 6, Lesson 3, Pages 312 - 332

Common Core Standards Alignment

ELA/Literacy	Mathematics	Technology	Career Ready Practice
<p>Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4) RST.6-8.1</p> <p>Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5) RST.6-8.8</p> <p>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</p> <p>Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4),(MS-ETS1-1),(MS-ETS1-3) WHST.6-8.1</p>	<p>Model with mathematics. (MS-LS2-5) MP.4</p> <p>Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5) 6.RP.A.3</p>	<p>8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools</p>	<p>CRP4. Communicate clearly and effectively and with reason</p>

Next Generation Science Standards and Foundations for the Unit
The performance expectations above were developed using the following elements from A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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<p>Engaging in Argument from Evidence</p> <ul style="list-style-type: none"> 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 on jointly developed and agreed-upon design criteria. (MS-LS2-5) <p>Asking Questions and Defining Problems</p> <ul style="list-style-type: none"> 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) <p>Developing and Using Models</p> <ul style="list-style-type: none"> Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) <p>Analyzing and Interpreting Data</p> <ul style="list-style-type: none"> Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) 	<p>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</p> <ul style="list-style-type: none"> 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) 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) <p>LS4.D: Biodiversity and Humans</p> <p>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)</p>	<p>Stability and Change</p> <ul style="list-style-type: none"> Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5) <p>Connections to Engineering, Technology, and Applications of Science</p> <p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <ul style="list-style-type: none"> 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) <p>-----</p> <p>Connections to Nature of Science</p> <p>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <ul style="list-style-type: none"> Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3) <p>Scientific Knowledge is Based on Empirical Evidence</p> <ul style="list-style-type: none"> Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4) <p>Science Addresses Questions About the Natural and Material World</p> <ul style="list-style-type: none"> Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)
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