Cedar Grove School District

Cedar Grove, NJ

2017 | Grade 7

Science

Approved by the Cedar Grove Board of Education

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Science – Grade 7

This curriculum was written in accordance with the

NEW JERSEY STUDENT LEARNING STANDARDS for SCIENCE.

These standards can be viewed at http://www.state.nj.us/education/cccs/2016/science/

Grade 7 - Science

Unit 1: Structure and Function | Instructional Time: 25 Days

How do cells contribute to the functioning of an organism?

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

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

MS-LS1-1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells
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.

Enduring Understandings	Essential Questions
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 or many and varied cells. Also, on the cell functioning as a whole system and primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.	• How do cells contribute to the functioning of an organism? • What processes are necessary for a plant or animal to stay alive? • How do the functions of cells support an entire organism? • What basic structures make up a cell?
Concepts	**Formative Assessment**
• Distinguish between living and nonliving things. • All living things are made up of cells, either one cell or many different numbers and types of cells. • Organisms may consist of one single cell (unicellular). • Organisms may consist of many different numbers and types of cells (multicellular). • Biology, and scientific discoveries have led to the development of entire industries and engineered systems. • The cell functions as a whole system. • Identify parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. • Within cells, special structures are responsible for particular functions. • A model can be used to describe the function of a cell as a whole	Students who understand the concepts are able to: • Conduct an investigation to produce data that provides evidence distinguishing between living and nonliving things. • Conduct an investigation to produce data supporting the concept that living things may be made of one cell or many and varied cells. • Distinguish between living and nonliving things. • Observe different types of cells that can be found in the makeup of living things. • Develop and use a model to describe the function of a cell as a whole.

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models:

This unit of study begins with students distinguishing between living and nonliving things. Students will conduct investigations examining both living and nonliving things and using the data they collect as evidence for making this distinction. During this investigation, students will study living things that are made of cells, either one cell or many different numbers and types of cells. Students will understand that life is a quality that distinguishes living things—

composed of living cells—from once-living things that have died or things that never lived. Emphasis is on students beginning to understand the cell theory by developing evidence that living things are made of cells, distinguishing between living and nonliving things, and understanding that living things may be made of one cell or many and varied cells.

As a continuation of their study of the cell, students will study the structure of the cell. This study begins with thinking of the cell as a system that is made up of parts, each of which has a function that contributes to the overall function of the cell. Students will learn that within cells, special structures—such as the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall—are responsible for particular functions. Students will develop and use a model to describe the function of the cell as a whole and the ways parts of the cell contribute to the cell's function. Models can be made of a variety of materials, including student-generated drawings, digital representations, or 3-D structures.

Performance Expectation

Science and Engineering Practices	DCI	Crosscutting Concepts
Planning and Carrying Out Investigations • Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (**MS-LS1-1**) **Developing and Using Models** • Develop a model to describe phenomena. (**MSLS1-2**)	**LS1.A: Structure and Function** • All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (**MS-LS1-1**) • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (**MS-LS1-2**)	**Scale, Proportion, and Quantity** • Phenomena that can be observed at one scale may not be observable at another scale. (**MS-LS1-1**) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (**MS-LS1-2**) - **Connections to Engineering, Technology and Applications of Science** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (**MS-LS1-1**)

Cross-Curricular Connections

English/Language Arts Standards	Mathematics Standards
• Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1) **WHST.6-8.7** • Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-2) **SL.8.5**	• Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-1),(MS-LS1-2) **6.EE.C.9**

21st Century Career Ready Practices

- **CRP4.** Communicate clearly and effectively and with reason.
- **CRP5.** Consider the environmental, social and economic impacts of decisions.
- **CRP6.** Demonstrate creativity and innovation.
- **CRP7.** Employ valid and reliable research strategies.
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP12.** Work productively in teams while using cultural global competence.

Grade 7 - Science

Unit 2: Growth, Development, and Reproduction of Organisms

Instructional Time: 25 Days

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

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

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

Enduring Understandings	Essential Questions
• Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from the 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. • 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, and fish growing larger in large ponds than do in small ponds.	• What influences the growth and development of an organism? • How do characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively? • How do environmental and genetic factors influence the growth of organisms?

Concepts	Formative Assessment
• Genetic factors as well as local conditions affect the growth of organisms. A variety of local environmental conditions affect the growth of organisms. • Genetic factors affect the growth of organisms (plant and animal). • The factors that influence the growth of organisms may have more than one cause.	*Students who understand the concepts are able to:* • Conduct experiments, collect evidence, and analyze empirical data. • 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.

• Some cause-and-effect relationships in plant and animal systems can only be described using probability.	

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models: Instruction should result in students being able to use arguments based on empirical evidence and scientific reasoning to support an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants.

- Students may observe examples of plant structures that could affect the probability of plant reproduction, including bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract pollen-transferring insects, and hard shells on nuts that squirrels bury. Possible activities could include plant experiments (e.g., students could count the number of butterflies on brightly colored plants vs. the number of butterflies on other types of plants and record the data they collect in a table), using microscopes/magnifiers to view plant structures (e.g., dissecting a lily), going on field trips, both virtual and actual (e.g., butterfly garden/botanical garden).
- Students may observe examples of animal behaviors that affect the probability of plant reproduction, which could include observing how animals can transfer pollen or seeds and how animals can create conditions for seed germination and growth.
- Students could then observe examples of animal behaviors (using videos, Internet resources, books, etc.) that could affect the probability of successful animal reproduction. These behaviors could include nest building to protect young from cold, herding of animals to protect young from predators, and colorful plumage and vocalizations to attract mates for breeding.
- Students may use evidence from experiments or other sources to identify the role of pollinators in plant reproduction. Instruction that results in students being able to construct an evidence-based scientific explanation for how environmental and genetic factors influence the growth of organisms could begin with students conducting experiments and collecting data on the environmental conditions that effect the growth of organisms (e.g., the effect of variables such as food, light, space, and water on plant growth).

Performance Expectation

Science and Engineering Practices	DCI	Crosscutting Concepts
Engaging in Argument from Evidence • Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (**MSLS1-4**) Constructing **Explanations and Designing Solutions** • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (**MS-LS1-5**)	**LS1.B: Growth and Development of Organisms** • Animals engage in characteristic behaviors that increase the odds of reproduction. • (**MS-LS1-4**) • Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (**MS-LS1-4**) • Genetic factors as well as local conditions affect the growth of the adult plant. (**MS-LS1-5**)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (**MSLS1-4**),(**MS-LS1-5**) • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (**MSLS1-4**),(**MS-LS1-5**) **Structure and Function** • Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts; therefore complex natural structures/systems can be analyzed to determine how they function. (**MS-LS1-4**), (**MSLS1-5**)

Cross-Curricular Connections

English/Language Arts Standards	Mathematics Standards
• Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4),(MS-LS1-5)	• Understand that a set of data collected to answer a statistical question has a distribution which can be

RST.6-8.1 • Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5) **RST.6- 8.2** • Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MSLS1-4) RI.6.8 Write arguments focused on discipline content. (MS-LS1-4) **WHST.6-8.1** • Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-5) **WHST.6-8.2** • Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5) **WHST.6-8.9**	described by its center, spread, and overall shape. (MSLS1-4),(MS-LS1-5) **6.SP.A.2** • Summarize numerical data sets in relation to their context. (MS-LS1-4),(MS-LS1- 5) **6.SP.B.4**
21st Century Career Ready Practices	
• **CRP4.** Communicate clearly and effectively and with reason. • **CRP5.** Consider the environmental, social and economic impacts of decisions. • **CRP6**. Demonstrate creativity and innovation. • **CRP7.** Employ valid and reliable research strategies. • **CRP8**. Utilize critical thinking to make sense of problems and persevere in solving them. • **CRP12.** Work productively in teams while using cultural global competence.	

Grade 7-Science

Unit 3: Inheritance and Variation of Traits | Instructional Time: 25 Days

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

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

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

Enduring Understandings	Essential Questions
• 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 in genetic variation.	• Why do kids look similar to their parents? • How do structural changes to genes (mutations) located on chromosomes affect proteins or affect the structure and function of an organism? • How do asexual reproduction and sexual reproduction affect the genetic variation of offspring?

Concepts	Formative Assessment
• Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. • Each distinct gene chiefly controls the production of specific proteins, which in turn affect the traits of the individual. • In addition to variations that arise from sexual reproduction, genetic information can be altered due to mutations. • Some changes to genetic material are beneficial, others harmful, and some neutral to the organism. • 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. • In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. • Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. • Punnett squares, diagrams, and simulations can be used to describe the cause-and-effect relationship of gene transmission from parent(s) to offspring and	• 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. • 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.

resulting genetic variation.	

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models: Using models, such as electronic simulations, physical models, or drawings, students will learn that genes are located in the chromosomes of cells and each chromosome pair contains two variants of each gene.

- Students will need to make distinctions between chromosomes and genes and understand the connections between them.
- Students will learn that chromosomes are the genetic material that is found in the nucleus of the cell and that chromosomes are made up of genes. They will also learn that each gene chiefly controls the production of specific proteins, which in turn affect the traits of the individual.
- Students will be able to show that in sexual reproduction, each parent contributes half of the genes acquired by offspring, whereas in asexual reproduction, a single parent contributes the genetic makeup of offspring.
- Using models such as Punnett squares, diagrams, and simulations, students will describe the cause-and-effect relationship between gene transmission from parents(s) to offspring and the resulting genetic variation.
- Using symbols to represent the two alleles of a gene, one acquired from each parent, students can use Punnett squares to model how sexual reproduction results in offspring that may or may not have a genetic makeup that is different from either parent.
- Students can observe the same mixing of genetic information using colored counters or electronic simulations. Using other models, students can show that asexual reproduction results in offspring with the same combination of genetic information as the parents.

Performance Expectation

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

	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**)	

Cross-Curricular Connections

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

21st Century Career Ready Practices

- **CRP4.** Communicate clearly and effectively and with reason.
- **CRP5**. Consider the environmental, social and economic impacts of decisions.
- **CRP6.** Demonstrate creativity and innovation.
- **CRP7.** Employ valid and reliable research strategies.
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP12.** Work productively in teams while using cultural global competence.

Grade 7-Science

Unit 4: Selection and Adaptation: | Instructional Time: 20 Days

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

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

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

Enduring Understandings	Essential Questions
• Emphasis is on using probability statements and propositional reasoning to construct explanations. • Synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modifications, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.	• Are genetically modified organisms (GMO) safe to eat? • How can changes to the genetic code increase or decrease an individual's chances of survival? • How can the environment effect natural selection?
Concepts	**Formative Assessment**
• Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment. • Natural selection may have more than one cause, and some cause-and-effect relationships within natural selection can only be described using probability. • Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions. • 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. • In artificial selection, humans choose desirable, genetically determined traits in to pass on to offspring. • Engineering advances have led to important discoveries in the field of selective breeding.	• 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. • Explain some causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time. • 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.

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models: In this unit of study, students will build on their prior knowledge by constructing explanations that describe how genetic variations increase

some individuals' probability of surviving and reproducing. Mathematical representations will be used to support explanations of how natural selection leads to increases and decreases of specific traits in populations over time.

- Students will construct explanations based on evidence that describes how genetic variations can provide a survival and reproductive advantage over other traits.
- Students will examine a variety of environmental factors that may influence the natural selection that is taking place in populations.
- Students will need to use simple probability statements and proportional reasoning to explain why each factor may or may not be responsible for the changes being observed.
- Students will compare and contrast the information gained from experiments, simulations, video, or multimedia sources with information gained from reading science and technical texts to support their explanations.
- After students have constructed their explanations, they will participate in collaborative discussions in small groups; in larger, teacher-led groups, or in pair.
- After students have developed a strong understanding of natural selection, they will need to begin gathering evidence from multiple sources, including print and digital, to support analysis of information about technologies that have changed how humans can influence the inheritance of desired traits in organisms (artificial selection).
- Students need to examine current technologies as well as the technologies that have led to these scientific discoveries. Some of the influences of humans on genetic outcomes in artificial selection that students can examine include genetic modifications, animal husbandry, and gene therapy.

Performance Expectation

Science and Engineering Practices	DCI	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (**MS-LS4-4**) **Obtaining, Evaluating, and Communicating Information** • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. **(MS-LS4-5**) **Using Mathematics and Computational Thinking** • Use mathematical representations to support scientific conclusions and design solutions. (**MS-LS4-6**)	**LS4.B: Natural Selection** • Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (**MS-LS4-4**) • In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (**MS-LS4-5**) **LS4.C: Adaptation** • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (**MS-LS4-6**)	**Cause and Effect** • Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (**MS-LS4-4**),(**MS-LS4-5**),(**MS-LS4-6**)

Cross-Curricular Connections

English/Language Arts Standards	Mathematics Standards
• Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-4),(MS-	• Model with mathematics. (MS-LS4-6) **MP.4** • Understand the concept of a ratio and use ratio language to describe a ratio relationship between two

LS4-5) **RST.6-8.1** • Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-4) **RST.6-8.9** • Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-4) **WHST.6-8.2** • Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5) **WHST.6-8.8** • Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-4) **WHST.6-8.9** • Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-4) **SL.8.1** • Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS4-4) **SL.8.4**	quantities. (MS-LS4-4),(MS-LS4-6) **6.RP.A.1** • Summarize numerical data sets in relation to their context. (MS-LS4-4),(MS-LS4-6) **6.SP.B.5** • Recognize and represent proportional relationships between quantities. (MS-LS4-4),(MS-LS4-6) **7.RP.A.2**
21st Century Career Ready Practices	
• **CRP2.** Apply appropriate academic and technical skills. • **CRP4.** Communicate clearly and effectively and with reason. • **CRP5.** Consider the environmental, social and economic impacts of decisions. • **CRP6.** Demonstrate creativity and innovation. • **CRP7.** Employ valid and reliable research strategies. • **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them. • **CRP12.** Work productively in teams while using cultural global competence.	

Grade 7-Science

Unit 5: Body Systems | Instructional Time: 20 Days

What are humans made of?

Students develop a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. Students will construct explanations for the interactions of systems in cells and organisms. Students understand that special structures are responsible for particular functions in organisms, and that for many organisms, the body is a system of multiple-interaction subsystems that form a hierarchy, from cells to the body.

Students construct explanations for the interactions of systems in cells and organisms and for how organisms gather and use information from the environment. The crosscuttings concepts of systems and system models and cause and effect provide a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in engaging in argument from evidence and obtaining, evaluating, and communicating information. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

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

Enduring Understandings	Essential Questions
• Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions.	• What are humans made of? • What is the evidence that a body is actually a system of interacting subsystems composed of groups of interacting cells? • How do organisms receive and respond to information from their environment?

Concepts	Formative Assessment
In multicellular organisms, the body is a system of multiple, interacting subsystems. • Subsystems are groups of cells that work together to form tissues. • Organs are groups of tissues that work together to perform a particular body function. • Tissues and organs are specialized for particular body functions. • Systems may interact with other systems. • Interactions are limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems. • Cause-and-effect relationships may be used to predict response to stimuli in natural systems.	*Students who understand the concepts are able to:* • Gather, read, and synthesize information from multiple appropriate sources about sensory receptors' response to stimuli. • Assess the credibility, accuracy, and possible bias of each publication and methods used. • Describe how publications and methods used are supported or not supported by evidence.

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models:Within this unit, students will use informational text and models to support their understanding that the body is a system of interacting subsystems.

- Instruction should begin with students understanding that the cell is a specialized structure that is a functioning system. Students will need to understand that different types of cells have different functions; therefore, each cell system is specialized to perform its particular function.
- Building on this understanding, students learn that different types of cells serve as subsystems for larger systems called tissues. Groups of specialized tissues serve as subsystems for organs that then serve as subsystems for body systems such as the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.

- Students need to understand how each body system interacts with other body systems. Emphasis is on the conceptual understanding that each system and subsystem is specialized for particular body functions; it does not include the mechanisms of one body system independent of others.

Performance Expectation

Science and Engineering Practices	DCI	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information • Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (**MS-LS1-8**) **Engaging in Argument from Evidence** • Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (**MS-LS1-3**)	**LS1.A: Structure and Function** • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (**MS-LS1-3**) **LS1.D: Information Processing** • Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (**MS-LS1-8**)	**Systems and System Models** • Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (**MS-LS1-3**) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural systems. (**MS-LS1-8**) - **Connections to Nature of Science** **Science is a Human Endeavor** • Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (**MS-LS1-3)**

Cross-Curricular Connections

English/Language Arts Standards	Mathematics Standards
• Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3) **RST.6-8.1** • Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.(MSLS1-3) **RI.6.8** • Write arguments focused on discipline content. (MS-LS1-3) **WHST.6-8.1** • Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.(MS-LS1-8) **WHST.6-8.8**	**N/A**

21st Century Career Ready Practices

- **CRP4.** Communicate clearly and effectively and with reason.
- **CRP5.** Consider the environmental, social and economic impacts of decisions.
- **CRP6.** Demonstrate creativity and innovation.
- **CRP7.** Employ valid and reliable research strategies.
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP12.** Work productively in teams while using cultural global competence.

Grade 7-Science

Unit 6: Organization for Matter and Energy Flow in Organisms | Instructional Time: 15 Days

Students provide a mechanistic account for how cells provide a structure for the plant process of photosynthesis in the movement of matter and energy needed for the cell. Students use conceptual and physical models to explain the transfer of energy and cycling of matter as they construct explanations for the role of photosynthesis in cycling matter in ecosystems. They construct scientific explanations for the cycling of matter in organisms and the interactions of organisms to obtain matter and energy from an ecosystem to survive and grow. They understand that sustaining life requires substantial energy and matter inputs, and that the structure and functions of organisms contribute to the capture, transformation, transport, release, and elimination of matter and energy.

The crosscutting concepts of matter and energy and structure and function provide a framework for understanding of the cycling of matter and energy flow into and out of organisms. Students are also expected to demonstrate proficiency in developing and using models. Students use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

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.
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

Enduring Understandings	Essential Questions
• Emphasis is on tracing movement of matter and flow of energy. Also, describing that molecules are broken apart and put back together and that in this process, energy is released.	• What is the role of photosynthesis in the cycling of matter and flow of energy into and out of an organism? • How is food rearranged through chemical reactions to form new molecules that support growth and/or release energy as this matter moves through an organism?
Concepts	**Formative Assessment**
• Food is rearranged through chemical reactions, forming new molecules that release energy as this matter moves through an organism. • 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.	*Students who understand the concepts are able to:* • Develop and use a model to describe how food is rearranged through chemical reactions.

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models:

- Students will construct explanations about the role of photosynthesis using evidence obtained from sources, including the students' own experiments or outside sources.
- Some experiments could include observing elodea releasing oxygen, depriving a plant of sunlight or water, or using glucose test strips.
- In this unit of study, emphasis is on the transfer of energy that drives the motion and/or cycling of matter. Students can represent the matter and energy involved in the process of photosynthesis using the equation for this reaction.
- Students can also trace the flow of energy using models such as energy pyramids.
- Using the data collected during their investigations and observations of simulations, students construct an explanation for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- Student learning will progress to developing and using models to describe how food is rearranged through chemical reactions. These reactions form new molecules that support growth and/or release energy as the matter moves through an organism.
- Students can integrate multimedia and visual displays into models to clarify information, strengthen claims and evidence, and add interest.

Performance Expectation		
Science and Engineering Practices	**DCI**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (**MS-LS1-6**) **Developing and Using Models** • Use a model based on evidence to illustrate the relationships between systems or between components of a system. (**HS-LS1-7**)	**LS1.C: Organization for Matter and Energy Flow in Organisms** • Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (**MS-LS1-6**) • Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (**MS-LS1-7**) **PS3.D: Energy in Chemical Processes and Everyday Life** • The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to **MS-LS1-6**) • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to **MS-LS1-7**)	**Energy and Matter** • Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (**MSLS1-6**) • Matter is conserved because atoms are conserved in physical and chemical processes. (**MS-LS1-7**) - **Connections to Nature of Science** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical connections between evidence and explanations. (**MS-LS1-6**)

Cross-Curricular Connections	
English/Language Arts Standards	**Mathematics Standards**
• Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-6) **RST.6-8.1** • Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6) **RST.6-8.2** • Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS1-6) **WHST.6-8.2** Draw evidence from informational texts to support	• Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (**MS-LS1-6) 6.EE.C.9**

analysis, reflection, and research. (MS-LS1-6) WHST.6-8.9	

21st Century Career Ready Practices

- **CRP4**. Communicate clearly and effectively and with reason.
- **CRP5.** Consider the environmental, social and economic impacts of decisions.
- **CRP6.** Demonstrate creativity and innovation.
- **CRP7.** Employ valid and reliable research strategies.
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP12.** Work productively in teams while using cultural global competence.

Grade 7-Science

Unit 7: Matter and Energy in Organisms and Ecosystems | Instructional Time: 15 Days

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

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

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

Enduring Understandings	Essential Questions
• Emphasis is on cause and effect relationships between resources and growth of individual organisms and the number of organisms in ecosystems during periods of abundant and scarce resources. • Predicting patterns of interactions in different ecosystems in terms of relationships among and between organisms and abiotic components of ecosystems. • Describing the conservation of matter and the flow of energy into and out of various ecosystems.	• How and why do organisms interact with their environment and what are the effects of these interactions? • How do changes in the availability of matter and energy effect populations in an ecosystem? • How do relationships among organisms, in an ecosystem, effect populations? • How can you explain the stability of an ecosystem by tracing the flow of matter and energy?
Concepts	**Formative Assessment**
• Organisms and populations of organisms are dependent on their environmental interactions with other living things and 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. • 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. • 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. • Decomposers recycle nutrients from dead plant or	*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. • Construct an explanation 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.

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.	

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models: Instruction should result in students being able to use arguments based on empirical evidence and scientific reasoning to support an explanation of how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants.

- Students may observe examples of plant structures that could affect the probability of plant reproduction, including bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract pollen-transferring insects, and hard shells on nuts that squirrels bury.
- Possible activities could include plant experiments (e.g., students could count the number of butterflies on brightly colored plants vs. the number of butterflies on other types of plants and record the data they collect in a table), using microscopes/magnifiers to view plant structures (e.g., dissecting a lily), going on field trips, both virtual and actual (e.g., butterfly garden/botanical garden).
- Students may observe examples of animal behaviors that affect the probability of plant reproduction, which could include observing how animals can transfer pollen or seeds and how animals can create conditions for seed germination and growth.
- Students could then observe examples of animal behaviors (using videos, Internet resources, books, etc.) that could affect the probability of successful animal reproduction. These behaviors could include nest building to protect young from cold, herding of animals to protect young from predators, and colorful plumage and vocalizations to attract mates for breeding.
- Instruction that results in students being able to construct an evidence-based scientific explanation for how environmental and genetic factors influence the growth of organisms could begin with students conducting experiments and collecting data on the environmental conditions that effect the growth of organisms (e.g., the effect of variables such as food, light, space, and water on plant growth).
- Students could then examine genetic factors (inherited traits) that influence the growth of organisms, including parental traits and selective breeding.

Performance Expectation

Science and Engineering Practices	DCI	Crosscutting Concepts
Analyzing and Interpreting Data • Analyze and interpret data to provide evidence for phenomena. (**MS-LS2-1**) **Constructing Explanations and Designing Solutions** • Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (**MS-LS2-2**) **Developing and Using Models** • Develop a model to describe phenomena. (**MSLS2-3**)	**LS2.A: Interdependent Relationships in Ecosystems** • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (**MS-LS2-1**) • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (**MS-LS2-1**) • Growth of organisms and population increases are limited by access to resources. (**MS-LS2-1**) • Similarly, predatory interactions	**Patterns** • Patterns can be used to identify cause and effect relationships. (MS-LS2-2) **Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1) **Energy and Matter** • The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur

	may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (**MS-LS2-2**) **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (**MS-LS2-3**)	in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

Cross-Curricular Connections	
English/Language Arts Standards	**Mathematics Standards**
• Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2) **RST.6-8.1** • Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1) **RST.6-8.7** • Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2) **WHST.6-8.2** • Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2) **WHST.6-8.9** • Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and	• Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS2-3) **6.EE.C.9** • Summarize numerical data sets in relation to their context. (MS-LS2-2) **6.SP.B.5**

issues, building on others' ideas and expressing their own clearly. (MS-LS2-2) **SL.8.1** • Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2) **SL.8.4** • Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS2-3) **SL.8.5**	
21st Century Career Ready Practices	
• **CRP4.** Communicate clearly and effectively and with reason. • **CRP5.** Consider the environmental, social and economic impacts of decisions. • **CRP6.** Demonstrate creativity and innovation. • **CRP7.** Employ valid and reliable research strategies. • **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them. • **CRP12.** Work productively in teams while using cultural global competence.	

Grade 7-Science

Unit 8: Interdependent Relationships in Ecosystems | Instructional Time:15 Days

Students build on their understandings of the transfer of matter and energy as they study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on a population. They construct explanations for the interactions in ecosystems and the scientific, economic, political, and social justifications used in making decisions about maintaining biodiversity in ecosystems. The crosscutting concept of *stability and change* provide a framework for understanding the disciplinary core ideas.

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-LS2-5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Enduring Understandings	Essential Questions
• Recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems. • Examples of ecosystem services could include: ▪ water purification ▪ nutrient recycling ▪ prevention of soil erosion	• What happens to ecosystems when the environment changes? • How can a single change to an ecosystem disrupt the whole system? • What limits the number and variety of living things in an ecosystem?
Concepts	**Formative Assessment**
• The characteristics of ecosystems can vary over time. • Disruptions to any physical or biological component of an ecosystem can lead to shifts in all the ecosystem's populations. • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines. • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • Small changes in one part of a system might cause large changes in another part.	*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. *Students who understand the concepts are able to:* • Construct a convincing argument that supports or refutes claims for solutions about the natural and designed world(s). • Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. • Create design criteria for design solutions for maintaining

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models: At the beginning of this unit of study, students will begin to collect empirical evidence that will be used to argue that physical or biological components of an ecosystem affect populations.

- Students will evaluate existing solutions for maintaining biodiversity and ecosystem services to determine which solutions are most promising.
- As part of their evaluation, students will develop a probability and use it to determine the probability that designed systems, including those representing inputs and outputs, will maintain biodiversity and ecosystem services. They will develop mathematical model(s) to generate data to test the designed systems and compare probabilities from the

models to observe frequencies. If the agreement is not good, they will explain possible sources of the discrepancy.

- Distinguish among facts, reasoned judgment based on research findings, and speculation.
- During this process, students will distinguish among facts reasoned judgment based on research findings, and speculation while reading text about maintaining biodiversity and ecosystem services. Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion.
- After determining that ecosystems are dynamic in nature, students may construct an argument to support an explanation for how shifts (large and/or small) in populations are caused by change to physical or biological components in ecosystems (e.g., gas explosions, tornados, mining, oil spills, clear cutting, hurricanes, volcanoes, etc.).
- Students will study the variety of species found in terrestrial and oceanic ecosystems and use the data they gather to make decisions about the health of the ecosystem.
- Students may compare, through observations and data analysis, the biodiversity before and after events affecting a specific area—for examples, the Pinelands, that were lost due to the creation of the reservoir; the underground coal fires in Centralia, PA, that caused people to abandon the town; the volcanic eruption in Mt. St. Helen's, WA; the nuclear reactor meltdown in Chernobyl, Ukraine.
- Students should recognize patterns in data about changes to components in ecosystems and make inferences about how these changes contribute to changes in the biodiversity of populations.
- Students should investigate and design investigations to test their ideas and develop possible solutions to problems caused when changes in the biodiversity of an ecosystem affect resources (food, energy, and medicine) as well as ecosystem services (water purification, nutrient recycling, soil erosion prevention) available to humans.

Performance Expectation		
Science and Engineering Practices	**DCI**	**Crosscutting Concepts**
Engaging in Argument from Evidence • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (**MS-LS2-4**) • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (**MS-LS2-5**)	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (**MS-LS2-4**) • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (**MS-LS2-5**) **LS4.D: Biodiversity and Humans** • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to **MS-LS2-5**) **ETS1.B: Developing Possible Solutions** • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a	**Stability and Change** • Small changes in one part of a system might cause large changes in another part. (**MS-LS2-4**),(**MS-LS2-5)** - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (**MS-LS2-5**) - ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes that objects and events in natural systems occur in

	problem.*(secondary to* **MS-LS2-5***)*	consistent patterns that are understandable through measurement and observation. (**MS-LS2-3**) **Scientific Knowledge is Based on Empirical Evidence** • Science disciplines share common rules of obtaining and evaluating empirical evidence. (**MS-LS2-4**) **Science Addresses Questions About the Natural and Material World** • Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (**MS-LS2-5**)

Cross-Curricular Connections

English/Language Arts Standards	Mathematics Standards
• Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4) **RST.6-8.1** • Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5) **RST.6-8.8** • Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-5) **RI.8.8** • Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4),(MS-ETS1-1),*(*MS-ETS1-3) **WHST.6-8.1** • Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2) **WHST.6-8.2**	• Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-3) **MP.2** • Model with mathematics. (MS-LS2-5) **MP.4** • Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-3) **7.EE.3** • Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5) **6.RP.A.3**

21st Century Career Ready Practices

- **CRP4.** Communicate clearly and effectively and with reason.
- **CRP5.** Consider the environmental, social and economic impacts of decisions.
- **CRP6.** Demonstrate creativity and innovation.
- **CRP7.** Employ valid and reliable research strategies.
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP12.** Work productively in teams while using cultural global competence.

Grade 7-Science

Unit 9: Weather and Climate — 20 Days

This unit is broken down into three sub-ideas: Earth's large-scale systems interactions, the roles of water in Earth's surface processes, and weather and climate. Students make sense of how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. A systems approach is also important here, examining the feedbacks between systems as energy from the Sun is transferred between systems and circulates though the ocean and atmosphere.

The crosscutting concepts of *cause and effect*, *systems and system models*, and *energy and matter* are called out as frameworks for understanding the disciplinary core ideas. In this unit, students are expected to demonstrate proficiency in *developing and using models* and *planning and carrying out investigations* as they make sense of the disciplinary core ideas. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Student Learning Objectives

New Jersey Student Learning Standards for Science/ NGSS

MS-ESS2-4	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
MS-ESS2-5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
MS-ESS2-6	Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Enduring Understandings	**Essential Questions**
• Emphasis is the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. • How air masses flow from regions of high pressure to low pressure, causing weather at a fixed location to change over time, and how sudden changes in weather can be predicted within probabilistic ranges. Show how patterns vary by latitude, altitude, and geographic land distribution.	• What factors interact and influence weather and climate? • What are the processes involved in the cycling of water through Earth's systems? • What is the relationship between the complex interactions of air masses and changes in weather conditions? • What are the major factors that determine regional climates?
Concepts	**Formative Assessment**
• Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. • Global movements of water and its changes in form are propelled by sunlight and gravity. • The motions and complex interactions of air masses result in changes in weather conditions. • Examples of data that can be used to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions include weather maps, diagrams, and visualizations; other examples can be obtained through laboratory experiments. • Air masses flow from regions of high pressure to regions of low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time. • Sudden changes in weather can result when different	• Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. • Model the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. • Collect data to serve as the basis for evidence for how the motions and complex interactions of air masses result in changes in weather conditions. • Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

air masses collide. • Cause-and effect-relationships may be used to predict changes in weather. • Patterns of atmospheric and oceanic circulation that determine regional climates vary by latitude, altitude, and geographic land distribution.	

Suggested Learning Activities

Suggested learning activities could encompass various labs, hands on activities, and models:During this unit, students will answer the question "What factors interact and influence weather and climate?" beginning with the cycling of water in Earth's systems.

- Models will be created and emphasis will be on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle.
- Students will model the continuous movement of water from land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation.
- Students will focus on the global movement of water and its changes in form that are driven by sunlight as it heats the Earth's surface water.
- The motions and complex interactions of air masses result in changes in weather conditions. The patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- Students will collect data from weather maps, diagrams, visualizations, and laboratory experiments to explain how the movements of air masses from regions of high pressure to regions of low pressure cause weather at a fixed location. For example, students can observe the movement of colored water that simulates the movement of hot and cold air masses.
- Students can observe the cooler water flowing in the direction of the warmer area and equate this with wind being created from the uneven heating of the Earth. Students will compare data collected from sources such as simulations, video, or experiments to identify the patterns of change in the movement of water in the atmosphere that are used to make weather predictions, understanding that any predictions are reported within probability ranges.
- Students will also make predictions about the conditions that result in sudden changes in weather.
- Students will use models, diagrams, maps, and globes to understand atmospheric and ocean circulation patterns. Students will model how the unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
- Digital models like NOAA videos can be used to help students visualize how variations in density due to temperature and salinity drive a global pattern of interconnected ocean currents. This can be demonstrated in the classroom using models in which colored water with different temperatures or water with different densities is added to clear tubs of water.
- Students can observe that the warmer water is pushed upwards by the colder water. This same demonstration can be used with water that has different salinities. Using a turntable and drawing a straight line from the middle to the edge can model the Coriolis effect.

Performance Expectation

Science and Engineering Practices	DCI	Crosscutting Concepts
Developing and Using Models • Develop and use a model to describe phenomena. (**MS-ESS2-6**) • Develop a model to describe unobservable mechanisms. (**MS-ESS2-4**) **Planning and Carrying Out Investigations** • Collect data to produce data to serve as the basis for evidence	**ESS2.C: The Roles of Water in Earth's Surface Processes** • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (**MS-ESS2-4**) • The complex patterns of the changes and the • movement of water in the	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (**MS-ESS2-5**) **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within

to answer scientific questions or test design solutions under a range of conditions. (**MS-ESS2-5**)	atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (**MS-ESS2-5**) • Global movements of water and its changes in form are propelled by sunlight and gravity. (**MS-ESS2-4**) • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (**MS-ESS2-6**) **ESS2.D: Weather and Climate** • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (**MS-ESS2-6**) • Because these patterns are so complex, weather can only be predicted probabilistically. (**MS-ESS2-5**) • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (**MS-ESS2-6**)	systems. **(MS-ESS2-6**) **Energy and Matter** • • Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (**MS-ESS2-4**)

Cross-Curricular Connections	
English/Language Arts Standards	**Mathematics Standards**
• Support the analysis of science and technical texts by citing specific textual evidence for how the motions and complex interactions of air masses result in changes in weather conditions. • Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with information that is gained from reading text about how the complex patterns of the changes and movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents are major determinants of local weather patterns. **(**MS-ETS1-2),(MS-ETS1-3) **RST.6-8.9** • Gather relevant information from multiple print and digital sources about how the complex patterns of the changes and movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of	• Reason abstractly and quantitatively by using data such as weather maps, diagrams, and visualizations or obtained through laboratory experiments to predict weather within probabilities ranges. • Understand that positive and negative numbers are used together to describe quantities having opposite directions or values. Use positive and negative numbers to represent changes in atmospheric and oceanic temperatures, explaining the meaning of 0 in each situation. • Reason abstractly and quantitatively. (MS-ESS2-5),(MS-ESS3-5) **MP.2** • Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and

local weather patterns; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ETS1-1) **WHST.6-8.8** • Include multimedia components and visual displays in presentations to clarify information about how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. (MS-ETS1-4) **SL.8.5** Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-5),(MS-ESS3-5) **RST.6-8.1** • Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-5) **RST.6-8.9** • Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS2-5) **WHST.6-8.8** • Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-6) **SL.8.5**	negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5) **6.NS.C.5** • Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-5) **6.EE.B.6**

21st Century Career Ready Practices

- **CRP2.** Apply appropriate academic and technical skills.
- **CRP4.** Communicate clearly and effectively and with reason.
- **CRP6.** Demonstrate creativity and innovation.
- **CRP7.** Employ valid and reliable research strategies.
- **CRP8.** Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP11.** Use technology to enhance productivity.
- **CRP12.** Work productively in teams while using cultural global competence.