PISCATAWAY
TOWNSHIP SCHOOLS

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Science 8

Content Area: Science
Grade Span: 8
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COURSE OVERVIEW

Description

Through engagement in the performance expectations arranged into the bundles that compose the eighth-grade science curriculum, students will continue to establish a conceptual understanding of science content and ideas from multiple disciplines of science. Building on the foundational understandings of matter and energy, students will be able to expand upon previous learning to make discoveries related to the effects of mixing more than one substance together. Students will develop understandings needed to describe phenomena related to the interactions of matter and the applications of matter interactions in society. Additionally, students develop an understanding of Earth's systems as they relate to weather, climate, and the cycling and dispersion of resources. Learning builds upon the previous learning from the 6th Grade "Earth's Systems" unit's learning of systems beneath Earth's surface (interactions of Earth's layers and volcanic eruptions). Also, students investigate human impact on these systems relative to the investigated topics of climate and resource consumption. Through investigation, students develop an understanding of the history and development of living organisms on Earth. Starting with the use of fossil records to develop conclusions related to evolutionary relationships, students will make discoveries related to natural selection, adaptations, and trait inheritance. Student investigation into inherited traits also involves study of genetic variation and reproductive processes of plants and animals.

Goals

This course aims to: ● develop student use of models as scientific explanation ● enable students to plan and conduct investigations ● develop student ability to analyze and interpret data, as well as utilize mathematical and computational thinking ● advance student ability to construct explanations clearly and effectively based on arguments from evidence ● allow students to obtain, evaluate, and communicate information ● allow students opportunities to model understanding of the core ideas within this course

Scope and Sequence

Unit	Topic (Bundle)	Length
Genetics and Natural Selection	How has life on Earth changed over time?	~6 weeks
	What processes fuel adaptations and long-term species survival?	~6 weeks
Matter and Its Interactions	How do we know when a chemical reaction has occurred?	~9 weeks
	How does thermal energy interact with matter during chemical reactions?	~3 weeks
Earth's Systems: Interactions and Human Impact	Why aren't minerals and groundwater distributed evenly across the world?	~6 weeks
	What systems interact and influence weather and climate?	~6 weeks

Resources

Suggested Resources:

- District-created learning materials
- Mosa Mack Science
- Gizmos (ExploreLearning)
- Kesler Science supplemental materials
- Albert.iO materials

UNIT 1: GENETICS AND NATURAL SELECTION

Summary and Rationale

Students investigate fossil records to identify patterns of changes in organisms throughout Earth's history. Students use these patterns to draw connections between organisms, developing conclusions that infer evolutionary relationships. In turn, these discoveries lead students to develop understandings relative to natural selection and adaptations. Students build on previous learning that Earth's rock strata can be used to organize Earth's history. Drawing from that understanding, students will analyze patterns found in fossil records to interpret the history of life on Earth. Students will use these identified patterns to draw connections between modern and fossil organisms to infer evolutionary relationships. Students will identify patterns evident in embryological development pictures to provide further support for arguments related to relationships among species. This builds on the previous understanding of evolutionary relationships to develop the idea that "evolutionary relationships" do not necessarily imply a single, straight-line relationship; but rather that modern species can be linked together as branches of common ancestry. Students investigate natural selection and adaptations as a process that takes place over long periods of time. Students will use mathematical representations to discuss how this process acts over generations in response to changes in environmental conditions to support successful survival and reproduction. Through modeling and data interpretation, students develop understandings related to how adaptations or traits that benefit survival are passed along in generations of organism populations. Student investigations lead to conclusions relative to the potential for genetic variation in organisms that undergo sexual and asexual reproduction; as well as the many factors (environmental, human-controlled, genetic) that impact growth, reproduction, and survival. Students develop models to describe the presence of variation of traits in organisms that undergo sexual reproduction and the lack of variation of traits in organisms that undergo asexual reproduction. Students use this understanding to justify arguments regarding the potential benefits of genetic variation for individual survival in populations. Additionally, students develop models to describe a conceptual understanding of the role mutations in genes play in organism survival. Students make discoveries related to characteristic animal behaviors that increase an organism's chances of successful reproduction (and therefore survival of their species). Students also develop understandings of certain plant structures that increase the likelihood of their reproduction through the influence of specific animal behaviors. Students develop an understanding of the differences between naturally occurring factors (environmental and genetic) that impact the growth and survival of organisms and the ways in which humans can influence some of these factors, including through artificial selection.

Recommended Pacing

~12 weeks total

State Standards (Performance Expectations)

Bundle 1: How has life on Earth changed over time?	~6 weeks total
Thread 1a: What can fossils teach us about the history of life on Earth?	~2 weeks

MS-LS4-1: Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Clarification Statement	Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.

Assessment Boundary	Assessment does not include the names of individual species or geological eras in the fossil record.
MS-LS4-2: Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	
Clarification Statement	Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.
Thread 1b: What evidence can be used to support the common ancestry of modern species?	~2 weeks
MS-LS4-3: Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.	
Clarification Statement	Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.
Assessment Boundary	Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.
Thread 1c: What influences a species' chances of survival over long periods of time?	~2 weeks
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.	
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.
Bundle 2: What processes fuel adaptations and long-term species survival?	~6 weeks
Thread 2a: How do parents' traits determine the traits of offspring?	~2 weeks
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 variance.	
Clarification Statement	Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.
MS-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.	
Clarification Statement	Emphasis is on using simple probability statements and proportional reasoning to construct explanations.
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.	
Clarification Statement	Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.
Assessment Boundary	Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.
Thread 2b: What other organism behaviors and interactions increase chances of survival of their species?	~2 weeks

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.	
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.
Thread 2c: How do environmental and genetic factors impact growth of organisms and what role can humans play in influencing these factors?	~2 weeks
MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	
Clarification Statement	Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.
Assessment Boundary	Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.
MS-LS4-5: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.	
Clarification Statement	Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

Instructional Focus

Unit Enduring Understandings (Crosscutting Concepts)

- **Bundle 1:**

Thread 1a:

- **Patterns:**
  - Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1)
  - Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
- **The Nature of Science:**
  - Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)
  - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1), (MS-LS4-2)

Thread 1b:

- **Patterns:** Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-3)

Thread 1c:

- **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-LS4-6)

➢ **Bundle 2**

Thread 2a:

- **Cause and Effect:**
  - Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)
  - Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4)
- **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)

Thread 2b:

- **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-LS1-4)

Thread 2c:

- **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-LS1-5), (MS-LS4-5)
- **Engineering, Technology, and Applications of Science:** 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)
- **The Nature of Science:** Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

Unit Essential Questions

- How has life on Earth changed over time?
- What can fossils teach us about the history of life on Earth?
- What evidence can be used to support the common ancestry of modern species?
- What influences a species' chances of survival over long periods of time?
- What processes fuel adaptations and long-term species survival?
- How do parents' traits determine the traits of offspring?
- What other organism behaviors and interactions increase chances of survival of their species?
- How do environmental and genetic factors impact growth of organisms and what role can humans play in influencing these factors?

Objectives

Students will know (DCIs):

➢ **Bundle 1:**

Thread 1a:

- **Evidence of Common Ancestry and Diversity**
  - The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms on Earth.
  - Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent.

Thread 1b:

- **Evidence of Common Ancestry and Diversity**
  - Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.

Thread 1c:

- **Adaptation**
  - Adaptation by natural selection actin 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.

➢ **Bundle 2:**

Thread 2a:

- **Growth and Development of Organisms**
  - Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring.
- **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 affect the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.
  - Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited.
- **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.
  - 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.
- **Natural Selection**
  - Natural selection leads to the predominance of certain traits in a population, and the suppression of others.

Thread 2b:

- **Growth and Development of Organisms**
  - Animals engage in characteristic behaviors that increase the odds of reproduction.
  - Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

Thread 2c:

- **Growth and Development of Organisms**
  - Genetic factors as well as local conditions affect the growth of the adult plant.
- **Natural Selection**
  - 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.

Students will be able to (Science and Engineering Practices):

➢ **Bundle 1:**

Thread 1a:

- Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1)
- Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)

Thread 1b:

- Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)

Thread 1c:

- Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)

➢ **Bundle 2:**

Thread 2a:

- Develop and use a model to describe phenomena. (MS-LS3-1), (MS-LS3-2)
- Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)

Thread 2b:

- 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)

Thread 2c:

- 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)
- 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)

Resources

See *Grade 8 Curriculum Resources* drive

Interdisciplinary Connections

Connections to NJSLS – English Language Arts

➢ **Bundle 1:**

Thread 1a:

- 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)
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1)
- WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS4-2)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2)
- SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2)
- SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS4-2)

Thread 1b:

- 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-LS4-3)

- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-3)
- RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3)

➢ **Bundle 2:**

Thread 2a:

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions (MS-LS4-4)
- 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)
- 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-LS4-4)
- WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS4-4)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-4)
- SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-4)
- SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS4-4)
- 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)

Thread 2b:

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-4)
- RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-4)
- WHST.6-8.1 Write arguments focused on discipline content. (MS-LS1-4)

Thread 2c:

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-5), (MS-LS4-5)
- RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-5)
- 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)
- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5)

Connections to NJSLS – Mathematics

- **Bundle 1:**

Thread 1a:

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

Thread 1c:

- MP.4 Model with mathematics. (MS-LS4-6)
- 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-6)
- 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS4-6)
- 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-LS4-6)

- **Bundle 2:**

Thread 2a:

- MP.4 Model with mathematics. (MS-LS3-2)
- 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS3-2)
- 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)
- 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS4-4)
- 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-LS4-4)

Thread 2b:

- 6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-4)
- 6.SP.B.4 Summarize numerical data sets in relation to their context. (MS-LS1-4)

Thread 2c:

- 6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. (MS-LS1-5)
- 6.SP.B.4 Summarize numerical data sets in relation to their context. (MS-LS1-5)

UNIT 2: MATTER AND ITS INTERACTIONS

Summary and Rationale

Students will build on previous learning relative to single substance physical properties to investigate what happens when more than one pure substance interacts. Students will be able to identify evidence that a chemical reaction has occurred, as well as describe conceptually what occurs at a molecular level during a reaction. Investigations into matter interactions reveal the changes of properties that occur during a chemical reaction. Students will be able to apply "evidence" for a chemical reaction to unique scenarios and phenomena to determine if chemical reactions occur during all interactions of matter. Students develop models to demonstrate a conceptual understanding that the total number of atoms does not change during a chemical reaction. While learning does not focus on atomic mass or students balancing equations, exposure to these concepts may be needed in developing the intended conceptual understandings. Students develop an understanding of natural resources used to develop synthetic materials through chemical reactions and the potential positive and negative societal impacts on these processes. Students build upon previous learning regarding thermal energy interactions with matter (phase changes, molecular movement changes) to discuss the presence of thermal energy during chemical reactions. Students use that new learning to design an application for the release or absorption of thermal energy by chemical processes.

Recommended Pacing

~ 11 weeks

State Standards (Performance Expectations)

Bundle 1: How do we know when a chemical reaction has occurred?	~9 weeks total
Thread 1a: Do chemical reactions always happen when matter interacts?	~3 weeks

MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Clarification Statement	Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.
Assessment Boundary	Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.

Thread 1b: How does matter change during a chemical reaction?	~3 weeks

MS-PS1-5: Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Clarification Statement	Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.
Assessment Boundary	Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.

Thread 1c: Where do we see chemical reactions outside of a science lab?	~2 weeks

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

Clarification Statement	Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.

Assessment Boundary	Assessment is limited to qualitative information.

Bundle 2: How does thermal energy interact with matter during chemical reactions?	~3 weeks total

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

Instructional Focus

Unit Enduring Understandings (Crosscutting Concepts)

- **Bundle 1:**

Thread 1a:

- **Patterns:** Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)
- **The Nature of Science:** Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2)

Thread 1b:

- **Energy and Matter:** Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
- **The Nature of Science:** Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

Thread 1c:

- **Structure and Function:** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)
- **Engineering, Technology, and Applications of Science:**
  - Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3)
  - The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. (MS-PS1-3)

- **Bundle 2:**
  - **Energy and Matter:** The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Unit Essential Questions

- How do we know when a chemical reaction has occurred?
- Do chemical reactions always happen when matter interacts?
- How does matter change during a chemical reaction?
- Where do we see chemical reactions outside of a science lab?
- How does thermal energy interact with matter during chemical reactions?

Objectives

Students will know (DCIs):

- **Bundle 1:**

Thread 1a:

- **Structure and Properties of Matter**
  - Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- **Chemical Reactions**
  - Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

Thread 1b:

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

Thread 1c:

- **Structure and Properties of Matter**
  - Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
- **Chemical Reactions**
  - Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

- **Bundle 2:**
  - **Chemical Reactions**
    - Some chemical reactions release energy, others store energy.
  - **Developing Possible Solutions**
    - A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
  - **Optimizing the Design Solution**
    - Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process – that is, some of the characteristics may be incorporated into the new design.
    - The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.

Students will be able to (Science and Engineering Practices):

- **Bundle 1:**

Thread 1a:

- Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

Thread 1b:

- Develop a model to describe unobservable mechanisms. (MS-PS1-5)

Thread 1c:

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)

- **Bundle 2:**

- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

Resources

See *Grade 8 Curriculum Resources* drive

Interdisciplinary Connections

Connections to NJSLS – English Language Arts

- **Bundle 1:**

Thread 1a:

- 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-PS1-2)
- 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-PS1-2)

Thread 1b:

- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-5)

Thread 1c:

- 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-PS1-3)
- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)

- **Bundle 2:**
  - • RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)
  - WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)

Connections to NJSLS – Mathematics

- **Bundle 1:**

Thread 1a:

- MP.2 Reason abstractly and quantitatively. (MS-PS1-2)
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-2)
- 6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. (MS-PS1-2)
- 6.SP.B.5 Summarize numerical data sets in relation to their context (MS-PS1-2)

Thread 1b:

- MP.2 Reason abstractly and quantitatively. (MS-PS1-5)
- MP.4 Model with mathematics. (MS-PS1-5)
- 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-5)

UNIT 3: EARTH'S SYSTEMS: INTERACTIONS AND HUMAN IMPACT

Summary and Rationale

Students construct an understanding that the distribution of Earth's resources is uneven due to past and current geosciences processes, as well as removal by humans. Students investigate the complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts on the development of these resources. Student focus is on categorization of Earth's natural resources, and primarily on the past geologic processes investigated in previous learning that resulted in the uneven distribution of certain resources including minerals, fresh water, petroleum, metal ores, and soil. Students develop an understanding of how some of Earth's materials, specifically minerals, are cycled through geoprocesses such as melting, crystallization, weathering, deformation, and sedimentation. Students develop an understanding of the impact human activity has on natural resources, both as short and long term consequences, positive as well as negative. Student discoveries lead to learning about how increases in human population and consumption of natural resources impact Earth's systems. 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 important in examining the feedbacks between systems as energy from the Sun is transferred between systems and circulates through the ocean and atmosphere. Students investigate both the natural and human contributions to global temperature change. Students investigate the continuous cycle of water through Earth's systems, as powered by the sun and gravity. Student discoveries lead to an application of previous learning related to energy transfer and states of matter. Student investigations focus on developing an understanding of how air masses interact with other systems (for example winds, landforms, and ocean temperatures/currents), to determine local weather patterns. Data for investigations can come in a variety of forms, including weather maps, diagrams, and visualizations. Students make discoveries related to observable patterns that result in regional climates, building upon previous learning on the Earth-Sun relationship. Student investigations focus on both the natural process that contribute to the rise in global temperature, as well as human activities. Student discoveries about the impact of human activities connects to the ideas built in the previous bundle related to natural resources and that human activities, such as the release of greenhouse gasses from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature.

Recommended Pacing

~ 12 weeks

State Standards (Performance Expectations)

Bundle 1: Why aren't minerals and groundwater distributed evenly across the world?	~6 weeks total
Thread 1a: How can we describe Earth's natural resources and their distribution?	~2 weeks

MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distribution of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Clarification Statement	Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).

Thread 1b: How do systems interact to move and distribute Earth's materials?	~2 weeks

MS-ESS2-1: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	
Clarification Statement	Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.
Assessment Boundary	Assessment does not include the identification and naming of minerals.
Thread 1c: If we think about the Earth as a spaceship, how might we treat resources?	~2 weeks
MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	
Clarification Statement	Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.
Bundle 2: What systems interact and influence weather and climate?	~6 weeks total
Thread 2a: How do interactions of systems result in changes in weather conditions?	~2 weeks
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.	
Clarification Statement	Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.
Assessment Boundary	A quantitative understanding of the latent heats of vaporization and fusion is not assessed.
MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.	
Clarification Statement	Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).
Assessment Boundary	Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.
Thread 2b: What are the major factors that determine regional climates?	~2 weeks
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.	
Clarification Statement	Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the

	Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.
Assessment Boundary	Assessment does not include the dynamics of the Coriolis effect.

Thread 2c: What is contributing to the rise in global temperature?	~2 weeks

MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused climate change over the past century.

Clarification Statement	Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.

Instructional Focus

Unit Enduring Understandings (Crosscutting Concepts)

- **Bundle 1:**

Thread 1a:

- **Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1)
- **Engineering, Technology, and Applications of Science:** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1)

Thread 1b:

- **Stability and Change:** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

Thread 1c:

- **Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-4)
- **Engineering, Technology, and Applications of Science:** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-4)
- **The Nature of Science:** Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes (MS-ESS3-4)

- **Bundle 2:**

Thread 2a:

- **Energy and Matter:** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)
- **Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)

Thread 2b:

- **Systems and System Models:** Models can be used to represent systems and their interactions – such as inputs, processes and outputs – and energy, matter, and information flows within systems. (MS-ESS2-6)

Thread 2c:

- **Stability and Change:** Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

Unit Essential Questions

- Why aren't minerals and groundwater distributed evenly across the world?
- How can we describe Earths natural resources and their distribution?
- How do systems interact to move and distribute Earth's materials?
- If we think about the Earth as a spaceship, how might we treat resources?
- What systems interact and influence weather and climate?
- How do interactions of systems result in weather conditions?
- What are the major factors that determine regional climates?
- What is contributing to the rise in global temperature?

Objectives

Students will know (DCIs):

➢ **Bundle 1:**

Thread 1a:

- **Natural Resources**
  - Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

Thread 1b:

- **Earth's Materials and Systems**
  - All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.

Thread 1c:

- **Human Impacts on Earth Systems**
  - Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

➢ **Bundle 2:**

Thread 2a:

- **The Roles of Water in Earth's Surface Processes**
  - Eater continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
  - The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
  - Global movements of water and its changes in form are propelled by sunlight and gravity.
- **Weather and Climate**
  - Because these patterns are so complex, weather can only be predicted probabilistically.

Thread 2b:

- **The Roles of Water in Earth's Surface Processes**
  - Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- **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.
- 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.

Thread 2c:

- **Global Climate Change**
  - Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

Students will be able to (Science and Engineering Practices):

- **Bundle 1:**

Thread 1a:

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)

Thread 1b:

- Develop and use a model to describe phenomena. (MS-ESS2-1)

Thread 1c:

- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)

- **Bundle 2:**

Thread 2a:

- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)
- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)

Thread 2b:

- Develop and use a model to describe phenomena. (MS-ESS2-6)

Thread 2c:

- Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5)

Resources

See *Grade 8 Curriculum Resources* drive

Interdisciplinary Connections

Connections to NJSLS – English Language Arts

- **Bundle 1:**

Thread 1a:

  - RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1)
  - WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)
  - WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1)

Thread 1b:

- SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-1)

Thread 1c:

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-4)
- WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-4)

- **Bundle 2:**

Thread 2a:

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-5)
- RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-5)
- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS2-5)

Thread 2b:

- SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-6)

Thread 2c:

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-5)

Connections to NJSLS – Mathematics

- **Bundle 1:**

Thread 1a:

- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-1)
- 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-1)

Thread 1c:

- 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-4)
- 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS3-4)
- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-4)
- 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-4)

- **Bundle 2:**

Thread 2a:

- MP.2 Reason abstractly and quantitatively. (MS-ESS2-5)
- 6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)

Thread 2c:

- MP.2 Reason abstractly and quantitatively. (MS-ESS3-5)
- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-5)
- 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-5)