PISCATAWAY TOWNSHIP SCHOOLS

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# Science 6

**Content Area:** Science
**Grade Span:** 6
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# COURSE OVERVIEW

## Description

Through engagement in the performance expectations arranged into the bundles that compose the sixth-grade science curriculum, students will establish a foundational understanding of the concepts of matter and energy. Students will be able to apply basic principles of these concepts to unique scenarios and phenomena related to them not only as separate concepts, but also related to their interactions. This foundational understanding extends into other disciplines of science of not only the 6th grade curriculum (for example cycles of energy and matter in ecosystems) but also into the 7th and 8th grade curricula. Additionally, students develop an understanding of Earth's various systems. Not only do students investigate systems as they exist now, but also students investigate how Earth has changed over its course of history due to the interactions of systems. Through investigation, students will also develop an understanding of the many interactions within an ecosystem. Students build off of their conceptual understanding of energy and matter to develop models of the cycling of energy and matter within an ecosystem. Additionally, students obtain information on the many relationships that exist within ecosystem organisms, including humans.

## 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 |
|---|---|---|
| Energy and Matter | How can energy and matter be described? | ~8 weeks |
| | How does thermal energy affect matter? | ~3 weeks |
| Systems That Shape Earth's Surface | How has Earth changed over time? | ~4 weeks |
| | What is happening below Earth's surface? | ~7 weeks |
| Ecosystems and Their Interactions | How do organisms and ecosystems interact? | ~6 weeks |
| | How do changes to an ecosystem impact its health and stability? | ~5 weeks |

## Resources

**Suggested Resources:**

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

# UNIT 1: ENERGY AND MATTER

| Summary and Rationale | |
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| Students will be able to identify multiple forms of energy as seen in different phenomena or scenarios. Additionally, students will be able to apply the ideas of energy transfer and conservation (energy does not disappear, it changes forms). Students will be able to describe matter based on its physical properties. This also includes an ability to model a state of matter on a particle level. Investigations into forms of energy will lead students to discoveries related to the relationship between potential and kinetic energy. Specifically, this would focus on energy transformation between the two forms and how energy is conserved in the process. Students model properties of a wave to demonstrate an understanding of how they can describe energy visually. Emphasis is placed on waves that require a medium to travel through, such as sound energy waves. Students develop a fundamental understanding of what makes up matter on an atomic/molecular level, with some focus on the basic molecular structure of solids, liquids, and gasses. Students practice with developing models of molecular structures of simple molecules. Through investigation, students discover how different physical properties of matter can be used to describe matter. Students will be able to explain and model how energy and matter interact to cause physical changes in matter. Specifically, the physical change investigated would be matter changing phases (solid to liquid, liquid to gas, liquid to solid, etc.) as being impacted by thermal energy transfer between matter. | |
| **Recommended Pacing** | |
| ~ 11 weeks total | |
| **State Standards (Performance Expectations)** | |
| **Bundle 1: How can energy and matter be described?** | ~8 weeks total |
| *Thread 1a: What are the relationships among forms of energy?* | ~3 weeks |
| **MS-PS3-1: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to <u>the mass of an object</u>** and to the speed of an object. | |
| Clarification Statement | Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball. |
| **MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.** | |
| Clarification Statement | Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. |
| Assessment Boundary | Assessment is limited to two objects and electric, magnetic, and gravitational interactions. |
| **MS-PS3-5: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** | |

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| Clarification Statement | Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object. | |
| Assessment Boundary | Assessment does not include calculations of energy. | |
| *Thread 1b: How can we describe properties of energy?* | | ~2 weeks |
| **MS-PS4-1: Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.** | | |
| Clarification Statement | Emphasis is on describing waves with both qualitative and quantitative thinking. | |
| Assessment Boundary | Assessment does not include electromagnetic waves and is limited to standard repeating waves. | |
| **MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.** | | |
| Clarification Statement | Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions. | |
| Assessment Boundary | Assessment is limited to qualitative applications pertaining to light and mechanical waves. | |
| *Thread 1c: How can we describe and identify unknown materials?* | | ~3 weeks |
| **MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.** | | |
| Clarification Statement | Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. | |
| Assessment Boundary | Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure. | |
| **Bundle 2: How does thermal energy affect matter?** | | ~3 weeks |
| **MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer *Integrates Engineering Design Performance Expectations*** | | |
| Clarification Statement | Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup. | |
| Assessment Boundary | Assessment does not include calculating the total amount of thermal energy transferred. | |
| **MS-PS3-4: Plan an investigation to determine the relationship among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** | | |
| Clarification Statement | Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added. | |
| Assessment Boundary | Assessment does not include calculating the total amount of thermal energy transferred. | |

| MS-PS1-4: Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. | |
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| Clarification Statement | Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium. |
| **MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** | |

## Instructional Focus

### Unit Enduring Understandings (Crosscutting Concepts)

- **Bundle 1:**

*Thread 1a:*

- **Scale, Proportion, and Quantity:** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1)
- **Systems and System Models:** Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)
- **Energy and Matter:** Energy may take different forms (e.g. energy in fields, thermal energy, and energy of motion). (MS-PS3- 5)
- **The Nature of Science:** Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-5)

*Thread 1b:*

- **Patterns:** Graphs and charts can be used to identify patterns in data. (MS-PS4- 1)
- **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-PS4-2)

*Thread 1c:*

- **Scale, Proportion, and Quantity:** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)

- **Bundle 2:**
  - **Cause and Effect:** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
  - **Scale, Proportion, and Quantity:** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-4)
  - **Energy and Matter:** The transfer of energy can be tracked as energy flows through a designed or natural system. (MSPS3-3)
  - **The Nature of Science:** Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-4)

### Unit Essential Questions

- How can energy and matter be described?
- What are the relationships among forms of energy?
- How can we describe properties of energy?

- How can we described and identify unknown materials?
- How does thermal energy affect matter?

**Objectives**

**Students will know (DCIs):**

- **Bundle 1:**

*Thread 1a:*

- **Definitions of Energy**
  - Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
  - A system of objects may also contain stored (potential) energy, depending on their relative positions.
- **Conservation of Energy and Energy Transfer**
  - When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

*Thread 1b:*

- **Wave Properties**
  - A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
  - A sound wave needs a medium through which it is transmitted.

*Thread 1c:*

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

- **Bundle 2:**

- **Structure and Properties of Matter**
  - Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
  - In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- **Definitions of Energy**
  - Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- **Conservation of Energy and Energy Transfer**
  - The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
  - Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- **Defining and Delimiting Engineering Problems**
  - The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.
- **Developing Possible Solutions**

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

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

- **Bundle 1:**

*Thread 1a:*

- Develop a model to describe unobservable mechanisms. (MS-PS3-2)
- Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1)
- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5)

*Thread 1b:*

- Develop and use a model to describe phenomena. (MS-PS4-2)
- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

*Thread 1c:*

- Develop a model to predict and/or describe phenomena. (MS-PS1-1)

- **Bundle 2:**
  - Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4)
  - Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3)
  - Develop a model to predict and/or describe phenomena. (MS-PS1-4)
  - Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

## Resources

See *Grade 6 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-PS3-1), (MS-PS3-5)
- 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-PS3-1)
- WHST.6-8.1 Write arguments focused on discipline content. (MS-PS3-5)
- SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2)

*Thread 1b:*

- SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1), (MS-PS4-2)

*Thread 1c:*

• 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-PS1-1)

- **Bundle 2:**

• RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3), (MS-PS3-4)

• 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-PS3-3), (MS-PS3-4)

• 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-PS1-4)

*Connections to NJSLS – Mathematics*

- **Bundle 1:**

*Thread 1a:*

• MP.2 Reason abstractly and quantitatively. (MS-PS3-1), (MS-PS3-5)

• 6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1), (MS-PS3-5)

• 6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio a:b with $b \neq 0$, and use rate language in the context of a ratio relationship. (MS-PS3-1)

• 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-PS3-1), (MS-PS3-5)

• 8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)

• 8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. (MS-PS3-1)

• 8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1), (MS-PS3-5)

*Thread 1b:*

• MP.2 Reason abstractly and quantitatively. (MS-PS4-1)

• MP.4 Model with mathematics. (MS-PS4-1)

• 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)

• 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1)

• 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-PS4-1)

• 8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS4-1)

*Thread 1c:*

• MP.2 Reason abstractly and quantitatively. (MS-PS1-1)

• MP.4 Model with mathematics. (MS-PS1-1)

• 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-1)

• 8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1)

- **Bundle 2:**

• MP.2 Reason abstractly and quantitatively. (MS-PS3-4)

• 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-PS3-4)

• 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,

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| credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4) |

# UNIT 2: SYSTEMS THAT SHAPE EARTH'S SURFACE

## Summary and Rationale

Investigations into Earth's history will lead students to discoveries about how the surface of Earth has changed over a large scale of time. Specifically, students will be able to defend arguments related to Continental Drift Theory and the shifting locations of major continents. Students will develop an understanding of specific Earth systems and how they interact. Students will be able to apply the ideas related to interacting systems below the surface of Earth to unique scenarios centered around human activities and natural hazards. A conceptual understanding of the layers of Earth will be developed as students learn about not only the structure and function of each layer, but also how each layer works together as parts of a system below the surface of Earth. Specifically, students will investigate shifting plates and volcanic eruptions as results of the interactions of Earth's layers. Students will develop ideas related to how human activity is impacted by natural hazards caused by the studied Earth systems. Specifically, students will focus on how humans can predict certain hazards caused by the interactions of Earth's layers to discover patterns related to earthquakes and volcanic eruptions.

## Recommended Pacing

~ 11 weeks total

## State Standards (Performance Expectations)

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| **Bundle 1: How has Earth changed over time?** | ~4 weeks |
| **MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.** | |
| Clarification Statement | Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches). |
| Assessment Boundary | Paleomagnetic anomalies in oceanic and continental crust are not assessed. |
| **MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.** | |
| Clarification Statement | Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions. |
| Assessment Boundary | Assessment does not include recalling the names of specific periods or epochs and events within them. |
| **Bundle 2: What is happening below Earth's surface?** | ~7 weeks total |
| *Thread 2a: How do systems below the Earth's surface interact with each other and with Earth's surface?* | ~3 weeks |
| **MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.** | |
| Clarification Statement | Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small |

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| | (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate. |

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| *Thread 2b: How do the interactions of certain Earth systems impact humans?* | ~4 weeks |

**MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.**

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| Clarification Statement | Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts). |

## Instructional Focus

**Unit Enduring Understandings (Crosscutting Concepts)**

- **Bundle 1:**
  - **Patterns:** Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)
  - **Scale, Proportion, and Quantity:** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-4)
  - **The Nature of Science:** Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)
- **Bundle 2:**

*Thread 2a:*

- **Scale, Proportion, and Quantity:** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)

*Thread 2b:*

- **Patterns:** Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
- **Engineering, Technology, and Applications of Science:** 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-ESS3-2)

**Unit Essential Questions**

- How has Earth changed over time?
- What is happening below Earth's surface?
- How do systems below the Earth's surface interact with each other and with Earth's surface?
- How do the interactions of certain Earth systems impact humans?

**Objectives**

**Students will know (DCIs):**

- **Bundle 1:**
  - **Plate Tectonics and Large-Scale System Interactions**
    - Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.
  - **The History of Planet Earth**
    - The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
    - Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.
- **Bundle 2:**

*Thread 2a:*

- **Earth's Materials and Systems**
  - The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

*Thread 2b:*

- **Earth's Materials and Systems**
  - The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.
- **Natural Hazards**
  - Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

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

**Bundle 1:**

- Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)
- 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-ESS1-4)

**Bundle 2:**

*Thread 2a:*

- 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-ESS2-2)

*Thread 2b:*

- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2)

## Resources

See *Grade 6 Curriculum Resources* drive

## Interdisciplinary Connections

*Connections to NJSLS – English Language Arts*

- **Bundle 1:**

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-3), (MS-ESS1-4)
- 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-ESS2-3)
- 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-ESS2-3)
- 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-ESS1-4)

➢ **Bundle 2:**

*Thread 2a:*

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2)
- 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-ESS2-2)

*Thread 2b:*

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1), (MS-ESS3-2)
- 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-ESS3-2)

*Connections to NJSLS – Mathematics*

➢ **Bundle 1:**

- MP.2 Reason abstractly and quantitatively. (MS-ESS2-3)
- 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-ESS2-3)
- 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-ESS2-3), (MS-ESS1-4)

➢ **Bundle 2:**

*Thread 2a:*

- MP.2 Reason abstractly and quantitatively. (MS-ESS2-2)
- 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-ESS2-2), (MS-ESS1-4)
- 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-ESS2-2)

*Thread 2b:*

- MP.2 Reason abstractly and quantitatively. (MS-ESS3-2)
- 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-ESS3-2)
- 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-ESS3-2)

# UNIT 3: ECOSYSTEMS AND THEIR INTERACTIONS

## Summary and Rationale

Students explore the many interactions between organisms and ecosystems.  Their discoveries lead them to understandings related to the varied dynamics between and within populations, and biotic/abiotic factors.
Students explore the many interactions between organisms and ecosystems.  Their discoveries lead them to understandings related to the varied dynamics between and within populations, and biotic/abiotic factors.
Students investigate the different dynamics that exist within specific organism populations, as well as the dynamics between different populations.  Specifically, students investigate interdependent relationships among populations (including predation and mutually beneficial relationships) and competition for limiting factors in ecosystems. Students gather information related to how changes to physical or biological components of an ecosystem can have effects on the populations living there.  Focus is on naturally occurring changes (increased rainfall, wildfires, etc.) and human activity (water/land usage, species removal or introduction) Students design possible solutions relative to the role humans can play to maintain overall ecosystem health and stability.  Students' focus is on monitoring and minimizing human environmental impacts and biodiversity.

## Recommended Pacing

~ 11 weeks total

## State Standards (Performance Expectations)

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| **Bundle 1: How do organisms and ecosystems interact?** | ~6 weeks total |
| *Thread 1a: How can you explain the stability of an ecosystem by tracing the flow of matter and energy?* | ~3 weeks |
| **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.** | |
| Clarification Statement | Emphasis is on tracing movement of matter and flow of energy. |
| Assessment Boundary | Assessment does not include the biochemical mechanisms of photosynthesis. |
| **MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** | |
| Clarification Statement | Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. |
| Assessment Boundary | Assessment does not include the use of chemical reactions to describe the processes. |
| *Thread 1b: What relationships exist between and within organism populations?* | ~3 weeks |
| **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.** | |
| Clarification Statement | Emphasis is on cause-and-effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources. |
| **MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** | |
| Clarification Statement | Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of |

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| | ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial. |
| **Bundle 2: How do changes to an ecosystem impact its health and stability?** | ~5 weeks |
| **MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** | |
| Clarification Statement | Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems. |
| **MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services. *Integrates Engineering Design Performance Expectations*** | |
| Clarification Statement | Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations. |
| **MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment *Integrates Engineering Design Performance Expectations*** | |
| Clarification Statement | Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land). |
| **MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** | |

## Instructional Focus

**Unit Enduring Understandings (Crosscutting Concepts)**

- **Bundle 1:**

*Thread 1a:*

- **Energy and Matter:**
  - Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1- 6)
  - The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)
- **The Nature of Science:**
  - Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)
  - Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

*Thread 1b:*

- **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)

- **Bundle 2:**
  - **Stability and Change:** Small changes in one part of a system might cause large changes in another part. (MSLS2-4), (MS-LS2-5)
- **Cause and Effect:** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
  - **The Nature of Science:**

- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)
- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

- **Engineering, Technology, and Applications of Science:** 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); (MS-ESS3-3)

**Unit Essential Questions**

- How do organisms and ecosystems interact?
- How can you explain the stability of an ecosystem by tracing the flow of matter and energy?
- What relationships exist between and within organism populations?
- How do changes to an ecosystem impact its health and stability?

**Objectives**

**Students will know (DCIs):**

- **Bundle 1:**

*Thread 1a:*

- **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.
- **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.
- **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.

*Thread 1b:*

- **Interdependent Relationships in Ecosystems**
  - Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.
  - 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.
  - Growth of organisms and population increases are limited by access to resources.
  - Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive,

predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

- **Bundle 2:**
  - **Human Impacts on Earth Systems**
    - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
  - **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.
    - 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.
  - **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.
  - **Developing Possible Solutions**
    - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

**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-LS1-6)
- Develop a model to describe phenomena. (MS-LS2-3)

*Thread 1b:*

- Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)
- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

- **Bundle 2:**
  - 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)
  - Apply scientific principles to design an object, tool, process, or system. (MS-ESS3-3)
  - Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

## Resources

See *Grade 6 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-LS1-6)
- • RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6)
- • 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-LS1-6)
- • WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-6)
- • SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS2-3)

*Thread 1b:*

- • RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1), (MS-LS2-2)
- • 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-LS2-1)
- • WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS2-2)
- • WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2)
- • SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS2-2)
- • SL.8.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2)

➢ **Bundle 2:**

- • RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-4)
- • RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
- • RI.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-LS-4), (MS-LS2-5)
- • WHST.6-8.1 Write arguments focused on discipline-specific content. (MS-LS2-4)
- • 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-ESS3-3)
- • 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-ESS3-3)
- • WHST.6-8.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-4)

*Connections to NJSLS – Mathematics*

➢ **Bundle 1:**

*Thread 1a:*

- • 6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6); (MS-LS2-3)

*Thread 1b:*

• 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS2-2)

- **Bundle 2:**

• MP.4 Model with mathematics. (MS-LS2-5)

• 6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5)

• 6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3)

• 7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS3-3)

• 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-ESS3-3)

• 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-ESS3-3)