



## Science Department Grade 7 Curriculum

### UNIT ONE

Timeframe (approximate)	
8 weeks	<p>Force and Motion</p> <p>Part A: How does a sailboat work? How does a fan car work? How does a mousetrap car work? How will I make my plane fly farther?</p> <ul style="list-style-type: none"> <li>● For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law).</li> <li>● Models can be used to represent the motion of objects in colliding systems and their interactions, such as inputs, processes, and outputs, as well as energy and matter flows within systems.</li> <li>● 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.</li> <li>● 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.</li> <li>● Specification of constraints includes consideration of scientific principles and other relevant knowledge, which are likely to limit possible solutions.</li> </ul> <p>Part B: Who can build the fastest sailboat? How does a fan car work? How does a mousetrap car work? How will I make my plane fly farther?</p> <ul style="list-style-type: none"> <li>● The change in an object’s motion depends on balanced (Newton’s first law) and unbalanced forces in a system Evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object includes qualitative comparisons of forces, mass, and changes in motion (Newton’s second law); frame of reference; and specification of units</li> <li>● The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change.</li> <li>● The greater the mass of the object, the greater the force needed to achieve the same change in motion.</li> <li>● For any given object, a larger force causes a larger change in motion</li> <li>● Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales</li> </ul>

8 weeks	<p><b>Energy</b></p> <p>Part A: Is it better to have an aluminum (baseball/softball) bat or a wooden bat?</p> <ul style="list-style-type: none"> <li>● Kinetic energy is related to the mass of an object and the speed of an object.</li> <li>● Kinetic energy has a relationship to mass separate from its relationship to speed.</li> <li>● Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed.</li> <li>● Proportional relationships among different types of quantities provide information about the magnitude of properties and processes</li> </ul> <p>Part B: What would give you a better chance of winning a bowling match, using a basketball that you can roll really fast, or a bowling ball that you can only roll slowly?</p> <ul style="list-style-type: none"> <li>● When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.</li> <li>● A system of objects may contain stored (potential) energy, depending on the objects' relative positions.</li> <li>● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the objects.</li> <li>● Models that could include representations, diagrams, pictures, and written descriptions of systems can be used to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems</li> </ul> <p>Part C: Who can design the best roller coaster?</p> <ul style="list-style-type: none"> <li>● When the kinetic energy of an object changes, energy is transferred to or from the object.</li> <li>● When the motion energy of an object changes, there is inevitably some other change in energy at the same time.</li> <li>● Kinetic energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).</li> </ul>
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<b>Unit 1</b>
Force and Motion
<b>Summary and Rationale</b>
<p>Students use system and system models and stability and change to understanding ideas related to why some objects will keep moving and why objects fall to the ground. Students apply Newton's third law of motion to related forces to explain the motion of objects. Students also apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of system and system models and stability and change provide a framework for understanding the disciplinary core ideas. Students demonstrate proficiency in asking questions, planning and carrying out investigations, designing solutions, engaging in argument from evidence, developing and using models, and constructing explanations and designing solutions. Students are also expected to use these practices to demonstrate an understanding of the core ideas. Students use the practices of analyzing and interpreting data, developing and using models, and engaging in argument from evidence to make sense of the relationship between energy and forces. Students develop their understanding of important qualitative ideas about the conservation of energy. Students</p>

understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students also understand the difference between energy and temperature, and the relationship between forces and energy. The crosscutting concepts of scale, proportion, and quantity, systems and system models, and energy and matter are called out as organizing concepts for these disciplinary core ideas. Students use the practices of analyzing and interpreting data, developing and using models, and engaging in argument from evidence. Students are also expected to use these practices to demonstrate an understanding of the core ideas.

### Recommended Pacing

16 weeks

### Standards

MS-PS2-1	Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects. * [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.]
MS-PS2-2	Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object. [Clarification Statement: Emphasis is on balanced (Newton’s First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton’s Second Law), frame of reference, and specification of units.]
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.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
MS-PS3-1	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and 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.]
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. [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 an object.]
Interdisciplinary Connections	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-PS2-1),(MS-ETS1-1),(MS-ETS1-2)
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1),(MS-PS2-2)
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-PS3-1)
WHST.6-8.1	Write arguments focused on discipline content. (MS-PS3-5) WHST.6-8.1
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) WHST.6-8.7
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-ETS1-1)
WHST.6-8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-ETS1-2)
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-ETS1-2),(MS-ETS1-3)
SL.8.5	Integrate multimedia and visual displays in presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2)
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) 8.F.A.3
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)
6.EE.A.2	Write, read, and evaluate expressions in which letters stand for numbers. (MS PS2-1),(MS-PS2-2)
7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-PS2-1),(MS-PS2-2)
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-PS2-1),(MS-PS2-2)
<b>Integration of Technology</b>	
8.1	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge
8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
<b>Instructional Focus</b>	
<b>Enduring Understandings:</b>	<b>Essential Questions:</b>
<p>For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton’s third law).</p> <p>The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.</p> <p>All positions of objects and the directions of forces and motions must be described in an arbitrarily</p>	<p>What is a force?</p> <p>What is friction?</p> <p>How does mass differ from weight?</p> <p>What is energy?</p> <p>What impacts motion?</p> <p>What are the Laws of Motion?</p> <p>How can we predict the motion of an object?</p> <p>What are the different types of energy?</p> <p>How is energy transferred or changed?</p> <p>What is speed?</p> <p>How do you calculate force?</p> <p>How do you calculate work?</p> <p>What is the difference between potential and kinetic energy?</p>

chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.

Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small, except when one or both of the objects have large masses—e.g., Earth and the sun.

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.

#### Relationship Between Energy and Forces

When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.

When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

How do you calculate kinetic energy?

What is gravitational potential energy?

What is gravity?

How do you calculate gravitational potential energy?

### Evidence of Learning (Assessments)

Upon completion of the unit, students will be able to engage in assessment tasks to show their ability to:

- Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects.
- Define a design problem involving the motion of two colliding objects that can be solved through the development of an object, tool, process, or system and that includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
- Evaluate competing design solutions involving the motion of two colliding objects based on jointly developed and agreed-upon design criteria.
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.
- Analyze and interpret data to determine similarities and differences in findings.
- Plan an investigation individually and collaboratively to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
- Design an investigation and 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. • Make logical and conceptual connections between evidence and explanations. • Examine the changes over time and forces at different scales to explain the stability and change in designed systems.
- Construct and interpret graphical displays of data to identify linear and nonlinear relationships of kinetic energy to the mass of an object and the speed of an object.
- Develop a model to describe what happens to the amount of potential energy stored in the system when the arrangement of objects interacting at a distance changes
- Use models to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. Models could include representations, diagrams, pictures, and written descriptions.

- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. Do not include calculations of energy.

Throughout the Unit:

- Pre-Assessment
- Entrance/Exit Tickets
- Formal quiz/Test assessments
- Inquiries/Labs

### Objectives (SLO)

Students will know:

For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).

Models can be used to represent the motion of objects in colliding systems and their interactions, such as inputs, processes, and outputs, as well as energy and matter flows within systems.

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.

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, which are likely to limit possible solutions.

The change in an object's motion depends on balanced (Newton's first law) and unbalanced forces in a system. Evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object includes qualitative comparisons of forces, mass, and changes in motion (Newton's second law); frame of reference; and specification of units

The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change.

Students will be able to: (What will students be able to do when they leave the classroom?)

Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. (MS-PS2-1)

Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. (MS-PS2-2)

Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1)

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and the speed of an object. (MS-PS3-1)

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. (MS-PS3-2)

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. (MS-PS3-5)

The greater the mass of the object, the greater the force needed to achieve the same change in motion.

For any given object, a larger force causes a larger change in motion.

Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different

Scales.

Kinetic energy is related to the mass of an object and the speed of an object.

Kinetic energy has a relationship to mass separate from its relationship to speed.

Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed.

Proportional relationships among different types of quantities provide information about the magnitude of properties and processes.

When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

A system of objects may contain stored (potential) energy, depending on the objects' relative positions. • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the objects.

Models that could include representations, diagrams, pictures, and written descriptions of systems can be used to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems.

When the kinetic energy of an object changes, energy is transferred to or from the object.

When the motion energy of an object changes, there is inevitably some other change in energy at the same time.

Kinetic energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).



## Suggested Resources/Technology Tools

Curriculum skeleton built upon NJDOE Model Curriculum for MS.

Resources for the course are teacher designed and based upon class needs, curriculum and aligned to standards.

Framework resource for the curriculum is the STC system from Carolina for which the district owns:

Teacher Guides

Literacy Magazines

Laboratory Exploration Manuals

<https://www.feelgoodteaching.com/2017/05/stem-challenge-boat-building.html>

<http://science.unctv.org/content/reportersblog/wood-aluminum-baseball-bats>

[https://www.sciencebuddies.org/science-fair-projects/project-ideas/Sports\\_p016/sports-science/baseball-bat-debate-wood-versus-aluminum#summary](https://www.sciencebuddies.org/science-fair-projects/project-ideas/Sports_p016/sports-science/baseball-bat-debate-wood-versus-aluminum#summary)

[https://www.sciencebuddies.org/science-fair-projects/project-ideas/Aero\\_p046/aerodynamics-hydrodynamics/how-far-will-paper-planes-fly#materials](https://www.sciencebuddies.org/science-fair-projects/project-ideas/Aero_p046/aerodynamics-hydrodynamics/how-far-will-paper-planes-fly#materials)

<https://dcmp.org/guides/TID7457.pdf>

<https://www.instructables.com/id/Paper-Roller-Coasters/>

<https://www.teachengineering.org>

<https://newsela.com>

<https://www.readworks.org>

<https://www.nj.gov/education/modelcurriculum/sci/6u4.pdf>

<https://www.nj.gov/education/modelcurriculum/sci/8u5.pdf>

## Modifications

**Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.**

### **General Modifications for students struggling to learn:**

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

### **ELL**

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow ELL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

### **G/T**

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests

- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

#### 504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

### 21ST CENTURY LIFE AND CAREER STANDARDS

*Please select all standards that apply to this unit of study:*

- Act as a responsible and contributing citizen and employee.
- Apply appropriate academic and technical skills.
- Attend to personal health and financial well being.
- Communicate clearly and effectively and with reason.
- Consider the environmental social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Employ valid and reliable research strategies.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership, and effective management.
- Plan education and career paths aligned to personal goals.
- Use technology to enhance productivity.
- Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: <http://www.state.nj.us/education/cccs/2014/career/9.pdf>

LINKS TO CAREERS:

<https://physics.osu.edu/ug-careers>

UNIT TWO

Timeframe (approximate)	
8 weeks	<p>Part A</p> <ul style="list-style-type: none"><li>● Organisms and populations of organisms are dependent on their environmental interactions with other living things.</li><li>● Organisms and populations of organisms are dependent on their environmental interactions with nonliving factors.</li><li>● In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources.</li><li>● Access to food, water, oxygen, or other resources constraints organisms' growth and reproduction.</li></ul> <p>Part B</p> <ul style="list-style-type: none"><li>● Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. (WOWBugs)</li><li>● Mutually beneficial interactions may become so interdependent that each organism requires the other for survival.</li><li>● The patterns of interactions of organisms with their environment, both its' living and nonliving components, are shared. (Ponds)</li><li>● Interactions within ecosystems have patterns that can be used to identify cause-and-effect relationships.</li><li>● Patterns of interactions among organisms across multiple ecosystems can be predicted.</li><li>● Patterns of interactions can be used to make predictions about the relationships among and between organisms and abiotic components of ecosystems.</li></ul>
8 weeks	<p>Part A</p> <ul style="list-style-type: none"><li>● Food webs are models that demonstrate how matter and energy are transferred among producers, consumers, and decomposers as the three groups interact within an ecosystem.</li><li>● Transfers of matter into and out of the physical environment occur at every level.</li><li>● Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments.</li><li>● Decomposers recycle nutrients from dead plant or animal matter back to the water in aquatic environments.</li><li>● The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.</li><li>● The transfer of energy can be tracked as energy flows through an ecosystem.</li><li>● Science assumes that objects and events in ecosystems occur in consistent patterns that are understandable through measurement and observation.</li><li>● Ecosystems are dynamic in nature.</li><li>● The characteristics of ecosystems can vary over time.</li><li>● Disruptions to any physical or biological components of an ecosystem can lead to shifts in all</li></ul>

	<p>the ecosystem's populations.</p> <ul style="list-style-type: none"> <li>● Small changes in one part of an ecosystem might cause large changes in another part.</li> <li>● Patterns in data about ecosystems can be recognized and used to make warranted inferences about changes in populations.</li> <li>● Evaluating empirical evidence can be used to support arguments about changes to ecosystems.</li> </ul> <p>Part B</p> <ul style="list-style-type: none"> <li>● Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems.</li> <li>● The completeness, or integrity, of an ecosystem's biodiversity, is often used as a measure of its health.</li> <li>● Changes in biodiversity can influence humans' resources, such as food, energy, and medicines.</li> <li>● Changes in biodiversity can influence ecosystem services that humans rely on.</li> <li>● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</li> <li>● A solution needs to be tested and then modified on the basis of the test results, in order to improve it.</li> <li>● Models of all kinds are important for testing solutions.</li> <li>● 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.</li> <li>● Small changes in one part of a system might cause large changes in another part.</li> <li>● Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes.</li> </ul>
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<b>Unit 2</b>
<b>Ecosystems: Interactions, Energy, and Dynamics</b>
<b>Summary and Rationale</b>
<p>Students analyze and interpret data, develop models, construct arguments, and demonstrate a deeper understanding of the cycling of matter, the flow of energy, and resources in ecosystems. They are able to study patterns of interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on populations. They also understand that the limits of resources influence the growth of organisms and populations, which may result in competition for those limited resources. They construct explanations for the interactions in ecosystems and the scientific, economic, political, and social justifications used in making decisions about maintaining biodiversity in ecosystems. The crosscutting concepts of matter and energy, systems and system models, patterns, and cause and effect provide a framework for understanding the disciplinary core ideas. Students demonstrate grade-appropriate proficiency in analyzing and interpreting data, developing models, asking questions, designing solutions and engaging in argument from evidence. Students are also expected to use these practices to demonstrate an understanding of the core ideas</p>
<b>Recommended Pacing</b>
16 weeks

Standards	
MS-LS2-1.	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS-LS2-2.	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS-LS2-3.	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
MS-LS2-4.	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-LS2-5.	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
Interdisciplinary Connections	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts.
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).
RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
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.
WHST.6-8.1	Write arguments to support claims with clear reasons and relevant evidence.
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.
WHST.6-8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
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.
SL.8.5	Integrate multimedia and visual displays in presentations to clarify information, strengthen claims and evidence, and add interest.
MP.4	Model with mathematics.
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems.
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.

6.SP.B.5	Summarize numerical data sets in relation to their context.
Integration of Technology	
SL.8.1	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
SL.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
<b>Instructional Focus</b>	
<b>Enduring Understandings:</b>	<b>Essential Questions:</b>
<p>Patterns of interactions exist among organisms across multiple ecosystems.</p> <p>The cycling of matter and flow of energy are important among the living and nonliving parts of an ecosystem.</p> <p>Populations are affected by changes to the physical and biological components of an ecosystem.</p> <p>The limits of resources will influence the growth of organisms and populations.</p>	<p>What is biodiversity?</p> <p>What is an ecosystem?</p> <p>What is a population?</p> <p>How and why do organisms interact with their environment and what are the effects of these interactions?</p> <p>What happens to ecosystems when the environment changes?</p> <p>What are the types of relationships that exist within ecosystems?</p> <p>What are food webs and how are they important in ecosystems?</p>
<b>Evidence of Learning (Assessments)</b>	
<p>Upon completion of the unit, students will be able to engage in assessment tasks to show their ability to:</p> <ul style="list-style-type: none"> <li>Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.</li> <li>Use cause-and-effect relationships to predict the effect of resource availability on organisms and populations in natural systems.</li> <li>Construct an explanation about interactions within ecosystems.</li> <li>Include qualitative or quantitative relationships between variables as part of explanations about interactions within ecosystems.</li> <li>Make predictions about the impact within and across ecosystems of competitive, predatory, or mutually beneficial relationships as abiotic (e.g., floods, habitat loss) or biotic (e.g., predation) components change.</li> <li>Develop a model to describe the cycling of matter among living and nonliving parts of an ecosystem.</li> <li>Develop a model to describe the flow of energy among living and nonliving parts of an ecosystem. Track the transfer of energy as energy flows through an ecosystem.</li> <li>Observe and measure patterns of objects and events in ecosystems.</li> <li>Construct an argument to support or refute an explanation for the changes to populations in an ecosystem caused by disruptions to a physical or biological component of that ecosystem. Empirical evidence and scientific reasoning must support the argument.</li> <li>Use scientific rules for obtaining and evaluating empirical evidence.</li> <li>Recognize patterns in data and make warranted inferences about changes in populations.</li> <li>Evaluate empirical evidence supporting arguments about changes to ecosystems.</li> </ul>	

- Construct a convincing argument that supports or refutes claims for
- Solutions about the natural and designed world(s).
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.
- Create design criteria for design solutions for maintaining biodiversity and ecosystem services.
- Evaluate competing design solutions based on jointly developed and design criteria.

Throughout the Unit:

- Pre-Assessment
- Entrance/Exit Tickets
- Formal quiz/Test assessments
- Inquiries/Labs

End of Unit:

- Ecosystems Unit Assessment

### Objectives (SLO)

Students will know:

Organisms and populations of organisms are dependent on their environmental interactions with other living things.

Organisms and populations of organisms are dependent on their environmental interactions with nonliving factors.

In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with others for limited resources.

The patterns of interactions of organisms with their environment, both its living and nonliving components, are shared.

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

Ecosystems are dynamic in nature.

Small changes in one part of an ecosystem might cause large changes in another part.

Students will be able to:

Identify how the characteristics of an ecosystem can change over time.

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

Identify cause-and-effect relationships based on interactions within ecosystems

Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Identify the variety of species found in Earth's terrestrial and oceanic ecosystems.

Describe how the changes in biodiversity can influence humans' resources, such as food, energy, and medicines.

## Suggested Resources/Technology Tools

Curriculum skeleton built upon NJDOE Model Curriculum for MS.

Resources for the course are teacher designed and based upon class needs, curriculum and aligned to standards.

Framework resource for the curriculum is the STC system from Carolina for which the district owns:

Teacher Guides

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[https://www.ducksters.com/science/ecosystems/world\\_biomes.php](https://www.ducksters.com/science/ecosystems/world_biomes.php)

<https://www.teachengineering.org>

<https://ngss.nsta.org/Resource.aspx?ResourceID=173>

<https://nj.pbslearningmedia.org/resource/lsp07.sci.life.eco.lpexpecosystems/exploring-the-systems-in-ecosystems/>

<https://newsela.com>

<https://www.readworks.org>

<http://www.learner.org/resources/series179.html>

<https://www.invasivespeciesinfo.gov/>

<https://www.nationalgeographic.org/encyclopedia/food-web/>

<https://www.brainpop.com/>

## Modifications

**Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.**

### **General Modifications for students struggling to learn:**

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

### **ELL**

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow ELL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

### **G/T**

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking



- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

#### 504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
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- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

## 21ST CENTURY LIFE AND CAREER STANDARDS

*Please select all standards that apply to this unit of study:*

- Act as a responsible and contributing citizen and employee.
- Apply appropriate academic and technical skills.
- Attend to personal health and financial well being.
- Communicate clearly and effectively and with reason.
- Consider the environmental social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Employ valid and reliable research strategies.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership, and effective management.
- Plan education and career paths aligned to personal goals.
- Use technology to enhance productivity.
- Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: <http://www.state.nj.us/education/cccs/2014/career/9.pdf>

*LINKS TO CAREERS:*  
[Agricultural Inspector](#)  
[Agricultural Technician](#)  
[Animal Breeder](#)  
[Animal Trainer](#)  
[Anthropologist](#)  
[Biologist](#)  
[Biology Teacher](#)  
[Marine Biologist](#)  
[Microbiologist](#)  
[Plant Scientist](#)  
[Zoologist and Wildlife Biologist](#)  
<https://www.environmentalscience.org/careers>

*OPTIONAL EXTENSIONS:*  
*Frog Dissection to wrap up the unit:*  
[Virtual Frog Dissection](#)  
[Frog Dissection - YouTube Video](#)

## UNIT THREE

Timeframe (approximate)	
6-8 weeks	<p>Part A:</p> <ul style="list-style-type: none"> <li>● The geologic time scale is used to organize Earth’s 4.6-billion-year-old history.</li> <li>● Rock formations and the fossils they contain are used to establish relative ages of major events in Earth’s history.</li> <li>● The geologic time scale interpreted from rock strata provides a way to organize Earth’s history.</li> <li>● Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.</li> <li>● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.</li> </ul> <p>Part B:</p> <ul style="list-style-type: none"> <li>● Energy drives the process that results in the cycling of Earth’s materials.</li> <li>● The processes of melting, crystallization, weathering, deformation, and sedimentation act together to form minerals and rocks through the cycling of Earth’s materials.</li> <li>● All Earth processes are the result of energy flowing and matter cycling within and among the planet’s systems.</li> </ul> <p>Part C:</p>

- Geoscience processes have changed Earth’s surface at varying time and spatial scales.
- Processes change Earth’s surface at time and spatial scales that can be large or small; many geoscience processes usually behave gradually but are punctuated by catastrophic events.
- Geoscience processes shape local geographic features.
- 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.
- Interactions among Earth’s systems have shaped Earth’s history and will determine its future.
- Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations.
- Time, space, and energy phenomena within Earth’s systems can be observed at various scales using models to study systems that are too large or too small.

Part D:

- Tectonic processes continually generate new seafloor at ridges and destroy old sea floor at trenches.
- 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.
- Patterns in rates of change and other numerical relationships can provide information about past plate motions.
- The distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.
- 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) provide evidence of past plate motions.

### Unit 3

#### Earth’s Systems

#### Summary and Rationale

Students examine geoscience data in order to understand processes and events in Earth’s history. Important crosscutting concepts in this unit are *scale, proportion, and quantity, stability and change, and patterns* in relation to the different ways geologic processes operate over geologic time. An important aspect of the history of Earth is that geologic events and conditions have affected the evolution of life, but different life forms have also played important roles in altering Earth’s systems. Students understand how Earth’s geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Students are expected to demonstrate proficiency in *analyzing and interpreting* data and *constructing explanations*. They are also expected to use these practices to demonstrate understanding of the core ideas.

#### Recommended Pacing

6-8 Weeks

## Standards

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.]
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.]
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 (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.]
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.]
<b>Interdisciplinary Connections</b>	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical text. (MS-ESS2-2), (MS-ESS2-3), (MS-ESS2-5)
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 flow chart, diagram, model, graph, or table). (MS-ESS2-3)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3),(MS-ESS2-5)
WHST.6-8.2	Write informative/explorative texts to examine a topic and convey ideas, concepts, and

	information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-6)
MP.2	Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)
6.EE.B.6	Use variables to represent numbers and write expressions when solving real-world or mathematical problems; understanding 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-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-ESS2-2),(MS-ESS2-3)
<b>Integration of Technology</b>	
Influence of Science, Engineering, and Technology on Society and the Natural World	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (MS-ESS3-2)
8.1 Educational Technology	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
8.2 Technology Education, Engineering, Design and Computational Thinking - Programming	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
<b>Instructional Focus</b>	
<b>Enduring Understandings:</b>	<b>Essential Questions:</b>
<p>Tectonic processes continually generate new ocean sea floor at ridges and destroy old seafloor at trenches.</p> <p>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.</p> <p>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.</p>	<p>How are rock formations and fossils used to establish the relative age of major events of history?</p> <p>How are rock strata distinguished from one another?</p> <p>How are rocks and minerals recycled to form Earth's materials?</p> <p>If no one was there, how do we know the Earth's history?</p> <p>What provides the forces that drive Earth's systems?</p> <p>What is the study of seismology?</p> <p>How are earthquake waves classified?</p> <p>What are the differences between the focus point and epicenter of an earthquake?</p> <p>How do plate tectonics interact with one another?</p>

<p>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.</p> <p>Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground format</p>	<p>What is the total amount of energy released from an earthquake called?</p> <p>The magnitude of an earthquake is measured using what scale?</p> <p>What is the Mercalli intensity scale?</p> <p>What is force?</p> <p>What is friction?</p> <p>What are convection currents?</p> <p>What are the parts of a volcano?</p> <p>How are volcanoes formed?</p> <p>How can volcanic eruptions be disruptive?</p> <p>How can volcanic eruptions be constructive?</p> <p>What instruments are used to study and predict volcanoes?</p> <p>What are ash clouds?</p>
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**Evidence of Learning (Assessments)**

Upon completion of the unit, students will be able to engage in assessment tasks to show their ability to:

- Construct a scientific explanation based on valid and reliable evidence from rock strata obtained from sources (including the students' own experiments).
- Construct a scientific explanation based on rock strata 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.
- Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- Construct a scientific explanation for how geoscience processes have changed Earth's surface at varying time and spatial scales based on valid and reliable evidence obtained from sources (including the students' own experiments).
- Construct a scientific explanation for how geoscience processes have changed Earth's surface at varying time and spatial scales based on the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- Collect evidence about processes that 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).
- Collect evidence about processes that change Earth's surface at time and spatial scales that can be small (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.
- Analyze and interpret data such as distributions of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.
- Analyze how science findings have been revised and/or reinterpreted based on new evidence about past plate motions.

## Objectives (SLO)

Students will know:

Geoscience processes have changed Earth's surface at varying time and spatial scales.

Processes change Earth's surface at time and spatial scales that can be large or small; many geoscience processes usually behave gradually but are punctuated by catastrophic events.

Geoscience processes shape local geographic features.

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.

Interactions among Earth's systems have shaped Earth's history and will determine its future.

Time, space, and energy phenomena within Earth's systems can be observed at various scales using models to study systems that are too large or too small.

Tectonic processes continually generate new seafloor at ridges and destroy old sea floor at trenches.

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.

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Students will be able to:

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 (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. (MS-ESS2-2)

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-ESS2-3)

## Suggested Resources/Technology Tools

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<https://earthquake.usgs.gov/learn/kids/kidsLearningLinks.php>

<https://newsela.com/read/elem-sci-volcano/id/26523/>

<https://newsela.com/read/govt-science-earthquakes/id/26756/>

<https://newsela.com/read/lib-convo-plate-tectonics-land-masses/id/37179/>

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<https://ngss.nsta.org/Resource.aspx?ResourceID=737>

[https://nj.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.lp\\_platetectonics/plate-tectonics/](https://nj.pbslearningmedia.org/resource/ess05.sci.ess.earthsys.lp_platetectonics/plate-tectonics/)

<https://www.esc.cam.ac.uk/research/research-groups/cambridge-volcano-seismology/kids-activities-and-teaching-resources>

<https://www.jpl.nasa.gov/edu/teach/activity/lava-layering-making-and-mapping-a-volcano/>

<https://www.nationalgeographic.org/media/plate-tectonics/>

[https://www.pbs.org/wgbh/nova/education/resources/subj\\_03\\_03.html](https://www.pbs.org/wgbh/nova/education/resources/subj_03_03.html)

<https://www.readworks.org/article/Finding-Fault/52281b0d-a5cf-4c3f-85ea-1ca966c42f89#!articleTab:content/>

<https://www.readworks.org/article/Mount-Pinatubo-and-the-Ring-of-Fire/3d0036cc-d11d-449a-ac45-9989db214acd#!articleTab:content/>

<https://www.readworks.org/article/Our-Changing-Earth-Plate-Tectonics-and-Large-Scale-System-Interactions/c3ea000a-8cd7-4bff-90f0-6298cfbfc36>

[www.teachengineering.org](http://www.teachengineering.org)

## Modifications

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- Plan education and career paths aligned to personal goals.
- Use technology to enhance productivity.
- Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: <http://www.state.nj.us/education/cccs/2014/career/9.pdf>

*LINKS TO CAREERS:*

[\*Cartographer or Photogrammetrist\*](#)

[\*Civil Engineering Technician\*](#)

[\*Civil Engineers\*](#)

[\*Climate Change Analyst\*](#)

[\*Environmental Engineer\*](#)

[\*Environmental Engineering Technician\*](#)

[\*Geographer\*](#)

[\*Geographic Information Systems Technician\*](#)

[\*Geoscientists\*](#)

[\*Petroleum Engineer\*](#)

[\*Soil Scientist\*](#)

[\*Surveyor\*](#)