7th Grade Unit 4 - Earth Systems

Content Area: **Science**
Course(s): **Science Grade 7**
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NJSLS - Science

SCI.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.
SCI.MS-ESS2-1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
SCI.MS-ESS2-2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
SCI.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.
SCI.MS-ESS3-1	Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
SCI.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.
SCI.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.
SCI.MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
SCI.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.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4, MS-ESS2-2, MS-ESS3-1)

Developing and Using Models

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

Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data

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

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

Asking Questions and Defining Problems

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)

Engaging in Argument from Evidence

Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

Disciplinary Core Ideas

ESS1.C: 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. (MS-ESS1-4)

ESS2.A: Earth's Materials and Systems

All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)

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. (MS-ESS2-2)

ESS2.B: 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. (MS-ESS2-3)

ESS2.C: The Roles of Water in Earth's Surface Processes

Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations. (MS-ESS2-2)

ESS3.A: Natural Resources

Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

ESS3.B: 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. (MS-ESS3-2)

ETS1.A: 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. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2)

Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution

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. (MS-ETS1-4)

Crosscutting Concepts

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, MS-ESS2-2)

Patterns

Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)

Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

Stability and Change

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

Cause and Effect

Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1)

Scientific Knowledge is Open to Revision in Light of New Evidence

Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)

Influence of Science, Engineering, and Technology on Society and the Natural World

All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1, MS-ETS1-1)

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, MS-ETS1-1)

Rationale and Transfer Goals

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 use practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts on the development of these resources. Students also understand that the distribution of these resources is uneven due to past and current geosciences processes or removal by humans. 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.

Enduring Understandings

The Earth is constantly changing.

The movement of water shapes Earth's surface.

Energy drives the process that results in the cycling of Earth's materials.

Earth's resources are finite.

Natural disasters can be predicted using science.

Essential Questions

How do we know that the Earth has an approximately 4.6-billion-year-old history?

What drives the cycling of Earth's materials?

Do all of the changes to Earth systems occur in similar time scales?

How is it possible for the same kind of fossils to be found in New Jersey and in Africa?

Why aren't minerals and groundwater distributed evenly across the world?

How can we predict and prepare for natural disasters?

Content - What will students know?

- The geologic time scale is used to organize Earth's 4.6-billion-year-old history.
- Rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history.
- 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.
- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
- Energy drives the process that results in the cycling of Earth's materials.
- The process of melting, crystallization, weathering, deformation, and sedimentation act together to form minerals and rocks through the cycling of Earth's materials.
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems.
- Energy flowing and matter cycling within and among the planet's systems derive from the sun and

Earth's hot interior.

- Energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
- Explanations of stability and change in Earth's natural systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale.
- 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 movement-both on the land and underground-cause weathering and erosion, which change the land's surface features and create underground formations.
- 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 continent (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches) provide evidence of past plate motions.
- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.
- All human activities draw on Earth's land, ocean, atmosphere, and biosphere resources and have both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.
- Minerals, fresh water, and biosphere resources are distributed unevenly around the planet as a result of past geologic processes.
- Cause-and-effect relationships may be used to explain how uneven distributions of Earth's mineral, energy, and groundwater resources have resulted from past and current geosciences processes.
- Resources that are unevenly distributed as a result of past processes include but are not limited to petroleum, metal ores, and soil.
- Mineral, fresh water, ocean, biosphere, and atmosphere resources are limited, and many are not

renewable or replaceable over human lifetimes.

- The distribution of some of Earth's land, ocean, atmosphere, and biosphere resources are changing significantly due to removal by humans.
- Natural hazards can be the result of interior processes, surface processes, or severe weather events.
- 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.
- 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.
- Data on natural hazards can be used to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- Data on natural hazards can include the locations, magnitudes, and frequencies of the natural hazards.
- Graphs, charts, and images can be used to identify patterns of natural hazards in a region.
- Graphs, charts, and images can be used to understand patterns of geologic forces that can help forecast the locations and likelihoods of future events.
- Technologies that can be used to mitigate the effects of natural hazards can be global or local.
- Technologies used to mitigate the effects of natural hazards vary from region to region and over time.

Skills - What will students be able to do?

- 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.
- Construct a scientific explanation based on valid and reliable evidence of how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geosciences processes.
- Obtain evidence from sources, which must include the student's own experiments.
- Construct a scientific explanation based on the assumption that theories and laws that describe the current geosciences process operate today as they did in the past and will continue to do so in the future.
- Analyze and interpret data on natural hazards to determine similarities and differences and to distinguish between correlation and causation.

Activities - How will we teach the content and skills?

- Inspire Science Earth and Space Science Unit 4 Module 1: Lesson 1 Analyzing the Rock and Fossil Records
- Inspire Science Earth and Space Science Unit 4 Module 1: Lesson 2 Building a Time Line
- Inspire Science Earth and Space Science Unit 4 Module 2: Lesson 1 Moving Continents
- Inspire Science Earth and Space Science Unit 4 Module 2: Development of a Theory
- Inspire Science Earth and Space Science Unit 4 Module 2: Lesson 3 Shaping Earth's Surface
- Inspire Science Earth and Space Science Unit 4 Module 2: Lesson 4 Changing Earth's Surface
- Inspire Science Earth and Space Science Unit 4 Module 2: Lesson 5 The Cycling of Earth's Materials
- Inspire Science Earth and Space Science Unit 4 Module 3: Lesson 1 Natural Resources
- Inspire Science Earth and Space Science Unit 4 Module 3: Lesson 2 Distribution of Resources
- Inspire Science Earth and Space Science Unit 4 Module 3: Lesson 3 Depletion of Resources
- Inspire Science Earth and Space Science Unit 4 Module 4: Lesson 1 Earthquake Risks

- Inspire Science Earth and Space Science Unit 4 Module 4: Lesson 2 Volcano Risks
- Inspire Science Earth and Space Science Unit 4 Module 4: Lesson 3 Severe Weather Risks
- MS-ESS1-4 Lesson Examples
- MS-ESS2-1 Lesson Examples
- MS-ESS2-2 Lesson Examples
- MS-ESS2-3 Lesson Examples
- MS-ESS3-1 Lesson Examples
- MS-ESS3-2 Lesson Examples

Evidence/Assessments - How will we know what students have learned?

- Inspire Science Labs
- Inspire Science STEM Module Projects
- Inspire Science Earth and Space Science Unit 4 Module 1 Assessment
- Inspire Science Earth and Space Science Unit 4 Module 2 Assessment
- Inspire Science Earth and Space Science Unit 4 Module 3 Assessment
- Inspire Science Earth and Space Science Unit 4 Module 4 Assessment
- Daily Warm Ups
- Daily Exit Tickets
- Grade 7 Unit 4 Benchmark Assessment

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• Rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history.	By the end of Grade 5, students understand that: Some kinds of plants and animals	4-ESS1-1 Activities 3-ESS3-1 Activities

• Natural hazards can be the result of interior processes, surface processes, or severe weather events.	that once lived on Earth are no longer found anywhere. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes.	

Key Resources

Inspire Science

Rock Cycle Journey

Geoscience processes & geographic features

NOAA Education Resources

21st Century Life and Careers

WRK.9.2.8.CAP.8	Compare education and training requirements, income potential, and primary duties of at least two jobs of interest.

Career Readiness, Life Literacies, & Key Skills

TECH.9.4.8.CI.1	Assess data gathered on varying perspectives on causes of climate change (e.g., cross-cultural, gender-specific, generational), and determine how the data can best be used to design multiple potential solutions (e.g., RI.7.9, 6.SP.B.5, 7.1.NH.IPERS.6, 8.2.8.ETW.4).
TECH.9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
TECH.9.4.8.CT.2	Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1).
TECH.9.4.8.CT.3	Compare past problem-solving solutions to local, national, or global issues and analyze the factors that led to a positive or negative outcome.
TECH.9.4.8.TL.1	Construct a spreadsheet in order to analyze multiple data sets, identify relationships, and facilitate data-based decision-making.
TECH.9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
TECH.9.4.8.IML.3	Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
TECH.9.4.8.IML.4	Ask insightful questions to organize different types of data and create meaningful visualizations.
TECH.9.4.8.IML.5	Analyze and interpret local or public data sets to summarize and effectively communicate the data.

Interdisciplinary Connections/Companion Standards

NJSLS ELA

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-4, MS-ESS2-2, MS-ESS2-3, MS-ESS3-1, MS-ESS3-2, MS-ETS1-1, MS-ETS1-2)

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-ESS2-3, MS-ESS3-2)

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-ESS2-3, MS-ETS1-2)

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-ESS1-4, MS-ESS2-2, MS-ESS3-1)

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-ETS1-2)

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 informational texts to support analysis, reflection, and research. (MS-ESS3-1, MS-ETS1-2)

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)

NJSLS Mathematics

MP.2 Reason abstractly and quantitatively. (MS-ESS2-2, MS-ESS2-3, MS-ESS3-2, MS-ETS1-1, MS-ETS1-2, MS-ETS1-4)

6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS1-4, MS-ESS2-2, MS-ESS2-3, MS-ESS3-1, MS-ESS3-2)

7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1, MS-ETS1-2)

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-ESS2-2, MS-ESS2-3,

MS-ESS3-1, MS-ESS3-2)

7.EE.B.6 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-ESS1-4)

7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)