

FOSS MS/NGSS Correlation

EARTH HISTORY, 2nd Edition

Version Date

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Inv	Inv Title	Part	Part Summary	Sessions	Content	NGSS Performance Expectations Addressed	Disciplinary Core Ideas (Framework)	Crosscutting Concepts	Asking questions (SP) / Defining problems (EP)	Developing and using models	Planning and carrying out investigations	Analyzing and interpreting data	Using mathematics and comp. thinking	Constructing explanations (SP) / Designing solutions (EP)	Engaging in argument from evidence	Obtaining, evaluating, and communicating information
1	Earth is Rock	1	What’s the Story of This Place? Students consider the history of Earth and begin to think about rock and landforms as a source of evidence for Earth’s past. An Earth tour provides a sense of the variety of landforms on the planet.	3	- Earth’s surface has of a variety of different landforms and water features. - Every place on Earth’s surface has a unique geological story. - Rocks hold the clues to the story of a place.			Graphs, charts, and images can be used to identify patterns in data. Models are limited in that they only represent certain aspects of the system under study.	SP	SP				SP		SP
1	Earth is Rock	2	Grand Canyon Rocks Students learn about the human history of the Grand Canyon, including some of the first scientific expeditions into the canyon. They examine rock samples from two sites in the canyon and learn how to identify limestone, sandstone, and shale.	3	- Every place on Earth’s surface has a unique geological story. - Rocks hold the clues to the story of a place. - Limestone, sandstone, and shale are rocks found in the Grand Canyon that can be identified by their characteristics.		ESS1.C: 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)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Graphs, charts, and images can be used to identify patterns in data.			SP	SP	SP		SP	SP
1	Earth is Rock	3	Correlating Grand Canyon Rocks Students compare the rocks at two sites in the Grand Canyon. They discover that the layers can be correlated between the two sites, indicating that the rock layers extend great distances throughout the Colorado Plateau.	2	- Rocks hold the clues to the story of a place. - Limestone, sandstone, and shale are rocks found in the Grand Canyon that can be identified by their characteristics.	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.	ESS1.C: 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)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Models can be used to represent systems and their interactions.	SP	SP	SP	SP	SP	SP	SP	SP
2	Weathering and Erosion	1	Sorting Earth Materials Students sort a rock mixture by hand and model how wind can separate earth materials. Students learn how earth materials can be categorized by size.	1	Particles of earth material can be categorized and sorted by size: clay, silt, sand, gravel, pebble, cobble, and boulder.	MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process.	ESS2.A: 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. (MS-ESS2-1)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	SP		SP	SP	SP	SP	SP	
2	Weathering and Erosion	2	Stream Tables Students observe erosion and deposition in a stream table and see how earth materials can be sorted by water.	2	Most landforms are shaped by slow, persistent processes that proceed over the course of millions of years: weathering, erosion, and deposition.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.	ESS2.C: 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)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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. Models can be used to represent systems and their interactions.	SP	SP	SP	SP	SP	SP	SP	SP
2	Weathering and Erosion	3	Weathering Students create sand and consider how rocks experience abrasion and other forms of physical weathering. Further relationships are drawn between erosional forces and the sorting that occurs in nature.	3	- Rock can be weathered into sediments by a number of processes including frost wedging, abrasion, chemical dissolution, and root wedging. - Most landforms are shaped by slow, persistent processes that proceed over the course of millions of years: weathering, erosion, and deposition.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.	ESS2.C: 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)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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.	SP	SP	SP	SP		SP	SP	SP

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2	Weathering and Erosion	4	Soil Students collect soil from their local environment and perform a simple test to determine which earth materials are found in the soil, answering questions about what happens to sediments that are not turned into sedimentary rocks.	4	Most sediments move downhill until they are deposited in a basin. Sediments that do not form rock can become widely distributed over Earth's surface as soil.	MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.	ESS2.A: 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. (MS-ESS2-1)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	SP	SP	SP	SP		SP		SP
3	Deposition	1	Sandstone and Shale Students consider how sediments accumulate in a basin, in a sorted fashion. They learn that substances in groundwater can form a cement, bonding sand particles together to form sandstone. Students then learn about shale formation.	1	- Sediments deposited by water usually form flat, horizontal layers. - Sediments turn into solid rock (such as sandstone, shale, and limestone) through the process of lithification, which involves compaction, cementation, and dissolution. - Sandstone is a sedimentary rock formed when particles of sand are cemented together. - Shale is a sedimentary rock formed when clay and silt particles are compacted and cemented together.	MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	SP	SP	SP	SP		SP		SP
3	Deposition	2	Limestone Students test two oceanic materials to see what might be a component of limestone. They determine that shells contain calcite and are likely to be in limestone.	1	- Sediments turn into solid rock (such as sandstone, shale, and limestone) through the process of lithification, which involves compaction, cementation, and dissolution. - Limestone is a sedimentary rock composed mainly of calcium carbonate, deposited in oceanic basins by physical, chemical, and biological processes.	MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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.	SP	SP	SP	SP		SP		
3	Deposition	3	Interpreting Sedimentary Layers Students learn about the principle of original horizontality, the principle of superposition, and uniformitarianism. They start to make inferences about past environments, based on evidence found in sedimentary rock layers.	3	- Sediments deposited by water usually form flat, horizontal layers. - The relative ages of sedimentary rock can be determined by the sequence of layers. Lower layers are older than higher layers. - The processes we observe today, such as weathering, erosion, and deposition, probably acted in the same way millions of years ago, producing sedimentary rocks.	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.	ESS1.C: 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)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	SP	SP	SP	SP	SP	SP	SP	SP
4	Fossils and Past Environments	1	Fossils Students look for fossils in Grand Canyon rocks, then identify a new set of fossils. Using modern environments for reference, students apply the principle of uniformitarianism to infer the ancient environments that formed Colorado Plateau rock layers.	3	- A fossil is any remains, trace, or imprint of a plant or animal that was preserved in Earth's crust during ancient times. - The fossil record represents what we know about ancient life and is constantly refined as new fossil evidence is discovered.	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.	ESS1.C: 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) LS4.A: The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation.	SP	SP		SP	SP	SP	SP	SP

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4	Fossils and Past Environments	2	A Long Time Ago A 46-meter (m) time line of Earth’s history is rolled out in front of students to help convey the vastness of geological time.	1	- Geological time extends from Earth’s origin to the present. - Earth’s history is measured in millions and billions of years.	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.	ESS1.C: 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) LS4.A: The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP		SP	SP	SP		SP
4	Fossils and Past Environments	3	Student Time Lines Students learn about units used to measure geological time and create their own scaled time lines to represent the history of Earth.	2	- Geological time extends from Earth’s origin to the present. - Earth’s history is measured in millions and billions of years.	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.	ESS1.C: 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)	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP		SP	SP	SP	SP	SP
4	Fossils and Past Environments	4	Index Fossils Index fossils are introduced as a tool to correlate rock layers, based on age. Students correlate several Colorado Plateau sites, then add the formation of the Grand Canyon rock layers to their time lines.	4	- The fossil record represents what we know about ancient life and is constantly refined as new fossil evidence is discovered. - Index fossils allow rock layers to be correlated by age over vast distances.	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 MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.	ESS1.C: 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) LS4.A: The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) LS4.A: Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP	SP	SP	SP	SP	SP	SP
5	Igneous Rock	1	Earth’s Layers Students study a new set of rocks that are not sedimentary. They identify some characteristics that differentiate these rocks from sedimentary rocks, namely the presence of crystals. Students study the layers of the earth to see what heat source might melt rocks.	1	- Earth is composed of layers of earth materials, from its hard crust of rock all the way down to its hot core. - Heat inside the earth melts rock; melted rock can cool and form igneous rocks.	MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP	SP	SP		SP		SP
5	Igneous Rock	2	Salol Crystals Students use salol to model the cooling of igneous rocks and design an experiment to test the effect of cooling rate on crystal formation. They find that slower cooling leads to larger crystal formation and apply that relationship to the environments in which igneous rocks form.	2	Molten rock cools quickly on the surface of the earth and can be identified by small mineral crystals. Molten rock that cools more slowly inside the Earth forms larger mineral crystals.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP	SP/EP	SP	SP	SP/EP	SP	SP
5	Igneous Rock	3	Types of Igneous Rocks Students consider a larger sample set of igneous rocks and determine which rocks are intrusive or extrusive, based on crystal size.	2	Molten rock cools quickly on the surface of the earth and can be identified by small mineral crystals. Molten rock that cools more slowly inside the Earth forms larger mineral crystals.	MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP	SP	SP	SP	SP	SP	SP

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6	Volcanoes and Earthquakes	1	Mapping Volcanoes and Earthquakes Students map volcanoes. When the class combines the data, specific patterns appear, such as the ring of volcanoes around the Pacific Ocean. Students map earthquakes and discover that the pattern generally matches that of volcanoes. They start to consider why that might be the case.	2	Volcanoes and earthquakes occur along plate boundaries.	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.	ESS3.B: 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)	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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.	SP	SP		SP	SP	SP	SP	SP		
6	Volcanoes and Earthquakes	2	Moving Continents Students are introduced to Wegener’s theory of continental drift and consider how it might be related to what is causing volcanoes and earthquakes at specific locations on Earth. Students learn about plate boundaries. They explain how plate boundaries might support Wegener’s theory and explain the existence of volcanoes and earthquakes at specific locations.	1	- Earth’s crust and solid upper mantle make up Earth’s plates. Plates can be the size of continents or larger or smaller. - Volcanoes and earthquakes occur along plate boundaries.	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.	ESS2.B: 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)	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. 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.	SP	SP		SP	SP	SP	SP	SP		
6	Volcanoes and Earthquakes	3	Plate Tectonics Students learn more about the layers of the earth, and convection is introduced. Students explain how plates might induce convection, and they investigate the type of plate boundary interactions that could result. A short video and a reading help students bring all the pieces together to understand the theory of plate tectonics.	3	- Earth’s plates “float” on top of the layer of viscous, semisolid earth material below, the asthenosphere. - The asthenosphere is a heated, semisolid, semifluid material that flows due to convection currents. - Plate movements result in plate-boundary interactions that produce volcanoes, earthquakes, and continental drift.	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. 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.	ESS2.B: 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) ESS3.B: 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) ESS3.A: 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)	Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems. 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.	SP	SP		SP		SP	SP	SP		
7	Mountains and Metamorphic Rocks	1	Plate Models Students use plate models to simulate interactions at plate boundaries that result from plates moving in different ways. They review what they have learned by watching animations of plate movements.	3	- Interactions between tectonic plates at their boundaries deform the plates, producing landforms on Earth’s surface. - Mountains form as a result of plate interactions.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales. 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.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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.	SP	SP		SP		SP	SP	SP		
7	Mountains and Metamorphic Rocks	2	Looking at Mountains Students observe and sort cards that contain information and images of diverse mountain types. They consider the relationship between mountain locations and plate boundaries.	1	- Interactions between tectonic plates at their boundaries deform the plates, producing landforms on Earth’s surface. - Mountains form as a result of plate interactions.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales. 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.	ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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.	SP			SP	SP	SP		SP		

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7	Mountains and Metamorphic Rocks	3	Metamorphic Rocks Students observe and describe a number of metamorphic rocks and consider how they might form. Focusing on heat and pressure, students observe a candy model for metamorphic rock formation. They compare rocks to identify the source rocks for specific metamorphic rocks. They organize what they have learned about rocks to develop the rock cycle.	4	- When plates interact, high heat and immense pressure can change rock into new forms of rock (metamorphic rock). - The rock cycle describes how rock is constantly being recycled and how each type of rock can be transformed into other rock types.	MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales.	ESS2.A: 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. (MS-ESS2-1) ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP	SP	SP		SP	SP	SP		
7	Mountains and Metamorphic Rocks	4	Shenandoah (Optional) Students explore Shenandoah National Park through a multimedia tour and samples of rocks similar to those at the park. They use this information and a stratigraphic column of the park’s rocks to interpret the geological history of the area.	2	- Interactions between tectonic plates at their boundaries deform the plates, producing landforms on Earth’s surface. - Mountains form as a result of plate interactions.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales. 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.	ESS2.A: 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-ESS-2) ESS2.B: 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)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. 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.	SP	SP	SP	SP		SP	SP	SP		
8	Geoscenarios	1	Introduction to the Project Students get a tour of the four geoscenario locations. Each team of students views a multimedia introductory tour specific to their topic and answers questions as a group.	1	- Geological processes help tell the story of a physical place. - Evidence and observations of a site’s geology provide clues to tell the geological story.	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. 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. MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	ESS3.A: 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: 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) ESS3.C: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)	Patterns can be used to identify cause and effect relationships. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. Stability might be disturbed either by sudden events or gradual changes that accumulate over time.	SP		SP	SP				SP		

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8	Geoscenarios	2	Team Synthesis Each student reviews information from a specialist and contributes detailed evidence to the team’s presentation. The group develops a time line of events related to their place or process. Students develop their presentation, based on the four guiding questions.	2	Knowledge of uplift, plate tectonics, volcanism, weathering, erosion, and fossil evidence plus the principles of uniformitarianism, superposition, and original horizontality can help tell the story of a place.	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. 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. MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems. MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	ESS3.A: 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: 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) ESS3.C: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4) ESS3.D: Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	Patterns can be used to identify cause and effect relationships. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. Stability might be disturbed either by sudden events or gradual changes that accumulate over time.	SP	SP	SP	SP	SP	SP/EP	SP/EP	SP/EP		
8	Geoscenarios	3	Presentations Teams split up so that two members explain the presentation to visiting groups, while the other two members visit other presentations, take notes, and ask questions. Then students will switch roles. After they have visited all the presentations, the teams do a self-assessment and a peer assessment.	2	- Geological processes help tell the story of a physical place. - Knowledge of uplift, plate tectonics, volcanism, weathering, erosion, and fossil evidence plus the principles of uniformitarianism, superposition, and original horizontality can help tell the story of a place.	MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales. 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. 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. MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems. MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.	ESS2.A: 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-ESS-2) ESS3.A: 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.C: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4) ESS3.D: Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	Patterns can be used to identify cause and effect relationships. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. Stability might be disturbed either by sudden events or gradual changes that accumulate over time.	SP	SP	SP	SP	SP	SP/EP	SP/EP	SP/EP		

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9	What is the Story of This Place?	1	Back to the Grand Canyon Students use what they have learned about Earth’s history and processes to interpret the rock evidence at the Grand Canyon and the geological history of the Grand Canyon.	2	Evidence that provides clues about Earth’s geological history comes from observing rocks, landforms, and other earth materials.	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. MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales	ESS1.C: 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: 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. (MS-ESS2-1) ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP		SP	SP	SP	SP	SP																																		
9	What is the Story of This Place?	2	Reviewing the Evidence Students review evidence from the previous investigations and put together a list of evidence and inferences that help tell Earth’s geological story. They review the processes that drive the rock cycle and the constructive and destructive processes that shape Earth. They explore various careers in the geosciences.	2	- Evidence that provides clues about Earth’s geological history comes from observing rocks, landforms, and other earth materials. - Scientists specialize in many different disciplines to collect and analyze evidence to help put together Earth’s geological history. - Scientists use a number of different tools and techniques to analyze and synthesize evidence obtained from Earth to tell its story.	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. MS-ESS2-1. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth’s surface at varying time and spatial scales	ESS1.C: 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: 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. (MS-ESS2-1) ESS2.A: 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-ESS-2)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	SP	SP		SP		SP	SP	SP																																		