MIDDLE SCHOOL EARTH SCIENCE: FOSSILS AND GEOSCIENCE PROCESSES

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. (SEP: 6; DCI: ESS2.A, ESS2.C; CCC: Scale/Prop.) [Clarifying Statements: 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 age of the Earth, distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. (SEP: 4; DCI: ESS2.B, ESS1.C; CCC: Patterns) [Clarifying Statements: 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-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. (SEP: 4; DCI: ESS3.B; CCC: Patterns, Technology) [Clarifying Statements: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

Geoscience processes such as weathering, erosion, and deposition are constantly changing Earth's surface. The planet's systems interact to shape Earth's history and future. By mapping the natural events in an area and understanding the geological forces involved, future events can be predicted and forecasted. Explanations can be constructed based on fossil and rock distribution and surface features.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- Mount St. Helen's surface looks different today than it did before it erupted.
- Seashells are found in the Badlands
- Volcanoes occur in the middle of the ocean.
- Pebbles being carried along by a river round and smooth.
- Rocks in the badlands have red in them.
- Engineers place rocks along the Missouri River.
- There are shelterbelts around farms in South Dakota.

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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 nature operate today as they did in the past and will continue to do so in the future. **Analyzing and Interpreting Data** ● Analyze and interpret data to provide evidence for phenomena. ● Analyze and interpret data to determine similarities and differences in findings.	**ESS2.A: Earth's Materials and Systems** ● The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. **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. **ESS1.C: The History of Planet Earth** ● Tectonic processes continually generate new ocean sea floor at ridges and destroy old seafloor at trenches. **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. **ESS3.B: Natural Hazards**	**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. **Patterns** ● Patterns in rates of change and other numerical relationships can provide information about natural systems. ● Graphs, charts, and images can be used to identify patterns in

	● 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.

The Earth's surface is constanting changing. Scientists continuously analyze and interpret data from Earth's system. The data scientists gather establishes a hypothesis on the age of the Earth. Distribution of rocks and fossils, past plate motions, and surface features all provide evidence of patterns observed in the system over different time periods and at various size scales. This evidence helps scientists create an explanation for how the Earth's surface has changed over many millennia.

Most changes occur gradually, such as microscopic particle movement that takes place during weathering, erosion and deposition. For example, minerals and rock are cycled through the rock cycle by means of various processes including melting, crystallization, weathering, deformation, and sedimentation. Scientists develop and use models to examine ways in which the cycling of Earth's materials results in crystal, mineral, and rock formation.

Scientists observe time and space phenomena at various scales by developing and using models that represent various landforms. They use information obtained from these models to construct explanations about how agents such as water, wind, and gravity change the land. These processes, both small and global in size, and their interactions have shaped and will continue to shape the Earth system.

Larger catastrophic events, such as earthquakes and volcanic eruptions, also account for changes to Earth's surface. This explanation can be established through a thorough understanding and analysis of geological forces, such as tectonic plate motion, and by mapping natural hazards in a region. Using the patterns occurring in the data and the resulting predictions, technologies can be developed to mitigate the effects of these catastrophic nature events.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

SEP Constructing Explanations and Designing Solutions

- Construct an explanation based on evidence for how the Mississippi River has gradually changed over time.
- Construct an explanation based on evidence for how a small change in continental movement have a big effect on landforms.

SEP Analyzing and Interpreting Data

- Analyze data and describe how fossil distribution around the world helps support the theory of plate tectonics.
- Analyze and interpret data of ancient land maps to provide evidence of continental drift.

CCC Scale Proportion and Quantity

- What observations of a model of the ocean floor give evidence that the seafloor is spreading?

CCC Patterns

- What do you predict will happen to [variable] in the future? Use the pattern you see in the data to justify your answer. (When time is a variable)What observations of a model of the ocean floor give evidence that the seafloor is spreading?
- Does the pattern in the data support the conclusion that tsunamis are caused by earthquakes ? Why or why not?
- Compare and contrast tectonic plate maps from past history to today to help explain how the Badlands in South Dakota formed.

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Observe** past and present *changes* to the Earth's surface (weathering, erosion and deposition) to identify patterns in those changes.
- **Construct an explanation** for how geoscience process have *changed* the Earth's surface.
- **Analyze and interpret data** on natural hazards to *forecast* future catastrophic events.
- **Obtain information** about the technologies that engineers have developed to mitigate the *effects* of natural hazards.
- **Organize given data** that represent the *distribution* and ages of fossils and rocks, continental shapes, seafloor structures, and/or age of oceanic crust.
- **Analyze data** to describe areas that are *susceptible* to the an earthquake .
- **Analyze data to provide evidence** for the *distribution* of seafloor structures (e.g., volcanic ridges at the centers of oceans, trenches at the edges of continents) combined with the *patterns* of ages of rocks of the seafloor.
- **Determine the age of Earth's material using data supporting the interpretation** that new crust forms at ocean ridges and then moves away as new crust continues to form and that the oldest crust is being destroyed at seafloor trenches.
- **Analyze and interpret data** to provide **evidence** for what past geologic processes or geologic event *altered* the Earth's surface.
- **Develop and use a model** of the rock cycle to **construct an explanation** for the formation of igneous, metamorphic, and sedimentary rock.
- **Construct explanations** for the cause of change in **Earth's materials** from one form to another.
- **Investigate data**, including **scale models**, find *patterns*, **construct an explanation**, and understand that Earth's plates have moved great distances over time.
  Construct explanations for the *patterns* they observe about convection currents and their effect on Earth. Students will justify the theory of plate tectonics by citing **evidence** of Earth's materials and *systems*.