### MS-ESS2 Earth’s Systems

**Students who demonstrate understanding can:**

**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, crystalization, 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 observed (such as plate motions or the uplift of large landforms 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.]

**MS-ESS2.4.** Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.  
[Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.]  
[Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

**MS-ESS2.5.** Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.  
[Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or graphs from laboratory experiments (such as with condensation).]  
[Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]

**MS-ESS2.6.** Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.  
[Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.]  
[Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

---

### Science and Engineering Practices

**Developing and Using Models**
- Modeling in 6–8 builds on K–S experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
  - Develop and use a model to describe phenomena. (MS-ESS2-1), (MS-ESS2-6)
  - Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

**Planning and Carrying Out Investigations**
- Planning and carrying out investigations in 6–8 builds on K–S experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
  - Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)

**Analyzing and Interpreting Data**
- Analyzing data in 6–8 builds on K–S experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
  - Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)

**Constructions Explanations and Describing Solutions**
- Constructing explanations and designing solutions in 6–8 builds on K–S experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
  - 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. (MS-ESS2-2)

---

### Disciplinary Core Ideas

**ESS1.C: The History of Planet Earth**
- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS-ESS1.C.GBE) (secondary to MS-ESS2-3)

**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 that 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, come together, pull apart. (MS-ESS2-3)

**ESS2.C: The Roles of Water in Earth’s Surface Processes**
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as runoff flows on land. (MS-ESS2-4)
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
- Variations in density due to variations in temperature and salinity drive a global pattern of interlinked ocean currents. (MS-ESS2-6)
- 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)

**ESS2.D: Weather and Climate**
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)
- Because these patterns are so complex, weather can only be predicted probabilistically.
- The ocean exerts a major influence on weather and climate by...
**MS-ESS2 Earth’s Systems**

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

<table>
<thead>
<tr>
<th>Connections to other DCIs in this grade band:</th>
<th><strong>RST.6.8.1</strong></th>
<th>Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articulation of DCIs across grade bands:</td>
<td><strong>RST.6.8.7</strong></td>
<td>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)</td>
</tr>
<tr>
<td><em>The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.</em></td>
<td><strong>RST.6.8.9</strong></td>
<td>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)</td>
</tr>
<tr>
<td><strong>WHST.6.8.2</strong></td>
<td>Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)</td>
<td></td>
</tr>
<tr>
<td><strong>WHST.6.8.8</strong></td>
<td>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-ESS2-5)</td>
<td></td>
</tr>
<tr>
<td><strong>SL.8.5</strong></td>
<td>Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-2),(MS-ESS2-3)</td>
<td></td>
</tr>
<tr>
<td><strong>Mathematics</strong></td>
<td><strong>MP.2</strong></td>
<td>Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)</td>
</tr>
<tr>
<td><strong>6.NS.C.5</strong></td>
<td>Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)</td>
<td></td>
</tr>
<tr>
<td><strong>6.EE.B.6</strong></td>
<td>Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS2-2),(MS-ESS2-3)</td>
<td></td>
</tr>
<tr>
<td><strong>7.EE.B.4</strong></td>
<td>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)</td>
<td></td>
</tr>
</tbody>
</table>

April 2014 ©2013 Achieve, Inc. All rights reserved.