

MS.Earth's Systems

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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, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]
- MS-ESS2-4. 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-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.** [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 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)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 6–8 builds on K–5 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 the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)

Disciplinary Core Ideas

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)

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 downhill flows on land. (MS-ESS2-4)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)

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)

Crosscutting Concepts

Cause and Effect

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

Energy and Matter

- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

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)

Connections to Engineering, Technology, and Applications of Science

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)

Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS3-1); **MS.PS1.B** (MS-ESS2-1),(MS-ESS3-1); **MS.PS2.B** (MS-ESS2-4); **MS.PS3.A** (MS-ESS2-4); **MS.PS3.B** (MS-ESS2-1); **MS.PS3.D** (MS-ESS2-4); **MS.LS2.B** (MS-ESS2-1); **MS.LS2.C** (MS-ESS2-1); **MS.ESS1.B** (MS-ESS2-1); **MS.ESS2.D** (MS-ESS3-1); **MS.ESS3.C** (MS-ESS2-1)

Articulation of DCIs across grade-bands: **3.PS2.A** (MS-ESS2-4); **4.PS3.B** (MS-ESS2-1),(MS-ESS2-4); **4.PS3.D** (MS-ESS3-1); **4.ESS2.A** (MS-ESS2-1); **4.ESS3.A** (MS-ESS3-1); **5.PS2.B** (MS-ESS2-4); **5.ESS2.A** (MS-ESS2-1); **5.ESS2.C** (MS-ESS2-4); **HS.PS1.B** (MS-ESS2-1); **HS.PS2.B** (MS-ESS2-4); **HS.PS3.B** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS3-1); **HS.PS4.B** (MS-ESS2-4); **HS.LS1.C** (MS-ESS2-1),(MS-ESS3-1); **HS.LS2.B** (MS-ESS2-1); **HS.ESS2.A** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS3-1); **HS.ESS2.B** (MS-ESS3-1); **HS.ESS2.C** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS3-1); **HS.ESS2.D** (MS-ESS2-4); **HS.ESS2.E** (MS-ESS2-1); **HS.ESS3.A** (MS-ESS3-1)

Common Core State Standards Connections:

ELA/Literacy –

- RST.6-8.1** Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1)
- 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-ESS3-1)
- WHST.6-8.9** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1)
- SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS2-1)

Mathematics –

- 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-ESS3-1)
- 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-ESS3-1)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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