Mini-Map for SCI.EE.12.ESS.Earth-2

Subject: Science
Earth and Space Science (ESS)
Grade band: 9–12

Grade-Level Expectation

DLM Essential Element	DLM Disciplinary Core Idea Family[1]	Framework Disciplinary Core Ideas
SCI.EE.12.ESS.Earth-2 Ask questions to determine how a change in one of Earth's systems (i.e., spheres) affects humans.	Earth and Space Science – Earth Systems	ESS2.A: Earth Materials and Systems ESS2.C: The Roles of Water in Earth's Surface Processes ESS3.C: Human Impacts on Earth Systems

[1] DLM Science Essential Elements organize Disciplinary Core Ideas (defined in the *Framework for K-12 Science Education*) into DCI families. By combining similar concepts within a domain, science content from the general education standards is reduced in depth, breadth, and complexity to provide access for students that qualify for the DLM alternate assessment.

Linkage Level Descriptions

Initial Precursor	Distal Precursor	Proximal Precursor	Target[2]
Identify change over time in the natural world.	Use questions to obtain an understanding that people (i.e., humans) get what they need to stay alive from different parts of Earth.	Use questions to obtain an understanding of how humans, who are part of the biosphere, interact with Earth's spheres.	Use questions to obtain an understanding that changes in one of Earth's spheres (i.e., atmosphere, geosphere, biosphere, or hydrosphere) can affect the availability of natural resources that humans use.

[2] The target linkage level description is a measurement target that describes the expectations (content and performance) of the Essential Element for assessment purposes.

Essential Element Three Dimensions

Each Essential Element is defined in the three dimensions described in the *Framework for K-12 Science Education*: disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). The table below lists the details of each dimension from the individual DLM Essential Element descriptions, with color-coding of dimensions corresponding to the Next Generation Science Standards (NGSS). The first row (in blue) lists the SEP(s) used to construct the Essential Element and describes ways each SEP could be incorporated. The second row (in orange) describes the science concepts within the DCI family related to this Essential Element. The third row (in green) lists the CCC(s) associated with the Essential Element and explains how each might be incorporated in the grade band (quoted from NSTA, 2013, matrix of CCCs). Note that the SEP is presented first here (rather than second, as it is in the full list of Essential Elements) to reflect the emphasis on practices in instruction and across the linkage levels. The final row (in white) includes examples of how the three dimensions could work together to support instruction for the Essential Element. These examples provide ideas for integrating the dimensions and are not exhaustive, nor are they intended to limit instruction.

Science and Engineering Practices	**Asking Questions and Defining Problems:** Asking questions and defining problems in grades 9–12 builds on K–8 experiences and progresses to developing and refining questions that lead to explanations. • Develop and evaluate testable questions. • Gain information through questioning to describe relationships.
Disciplinary Core Ideas	**Earth Systems** • Earth's major systems are the geosphere, hydrosphere, atmosphere, and biosphere (see SCI.EE.12.ESS-Earth-1). • These spheres are dynamic and interact amongst themselves (see SCI.EE.12.ESS-Earth-1). o Any natural substance that humans use can be considered a natural resource. o Resource availability determines where humans live. o Limits on ecosystems are based on resource availability (both living and nonliving resources). o Changes in biodiversity affect humans' access to living and nonliving resources (see SCI.EE.12.LS-EcoHlth-1).

Crosscutting Concepts	**Cause and Effect: Mechanism and Explanation**: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. • Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects. **Systems and System Models**: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. • Systems can be designed to do specific tasks. • When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. • Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. **Stability and Change**: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand. • Much of science deals with constructing explanations of how things change and how they remain stable. • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. • Feedback (negative or positive) can stabilize or destabilize a system. • Systems can be designed for greater or lesser stability.

How three dimensions support instruction for this Essential Element	Students can use questions to learn about cause-and-effect relationships in how each of Earth's spheres impact the other spheres. For example, students can understand that human changes to Earth's spheres affect what resources are available for use. These interactions also relate to concepts of stability and change in systems as students can determine how things change in Earth's systems and how they remain stable. Through these interactions between spheres, students can learn about the inputs, outputs, and initial conditions of Earth's interacting systems. For example, students can identify natural resources used by humans in all of Earth's spheres and understand that changes in different parts of Earth's systems can impact the availability of resources for human use.

Instructional Resources

Resources
Learning modules and additional science instructional resources can be found at https://www.dlmpd.com/science/
A glossary defining key science terms found in the Essential Elements can be found at DLM Glossary for Science Learning Maps.

Link to Text-Only Map

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