MIDDLE SCHOOL EARTH SCIENCE: ENERGY ON EARTH

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-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process (SEP: 2; DCI: ESS2.A; CCC: Stability/Change). [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.]

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 (SEP: 6; DCI: ESS3.A ; CCC: Cause/Effect , Technology). [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).]

Content Overview

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

The human population relies on resources from the Earth for survival. Humans need resources to survive in an ever-changing world. Many of these resources cycle through systems and geoscience processes. Natural resources are located all over world as a result of geoscience processes, however, they are unevenly distributed because many of them need specific conditions to form. One of the conditions needed to form natural resources is energy. Energy cycles through Earth, but certain landforms either hinder or promote the cycle of energy. Due to the uneven distribution humans are stretching natural resources to their limit. Stretching resources to their limit may have a negative impact on energy flow in the future unless action is taken to lessen the impact.

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.

- Waves appear above the road during the summer.
- Alluvial fans form when a mountain stream enters into a flat valley.
- Deltas form at the end of rivers when the water enters a larger body of water.
- Some people have wells and others do not.
- Rocks have large crystals and small crystals.
- Some farmers grow crops while others have livestock and no crops.
- Windmills draw up water from an aquifer in the sandhills of Nebraska.

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
Planning and Carrying Out Investigations ● Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. **Developing and Using Models** ● Develop and use a model to describe phenomena.	**ESS2A: 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. **ESS3A: 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.	**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 **Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Students should be able to develop a model showing that Earth's systems have cycles that interact with each other. These cycles are predictable systems. Each system's stability and changes may be examined by observing patterns in the system over time at various scales in size. All of Earth's geologic processes are the result of energy flowing (from the sun and interior of Earth) in the form of convection currents and matter cycling among and within the planet's systems.

As a result of these geologic processes an uneven distribution of mineral, energy, and groundwater resources were formed. For example, metallic ores are most abundant in areas with past geothermal and volcanic activity associated with subduction zones. Fossil fuels are found in areas that were at one time seas due to the burial of organic marine sediments. Grasslands and plains have flat fertile land used for growing crops that comes from active weathering deposition of rock. Through cause and effect relationships, students can construct a scientific explanation, based on evidence, for how the uneven distributions of mineral, energy, and groundwater resources are the result of past and current geologic processes. Students can evaluate competing data, hypotheses, and conclusions in scientific texts to determine how materials continuously move through Earth's systems. Students can evaluate the cause and effect relationship between the formation of resources and the connection with the flow of energy. Many renewable resources should be able to replenish themselves as long as the

energy cycle remains stable.

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.

Resources to inform your formative assessment.

http://stemteachingtools.org/brief/30
http://stemteachingtools.org/brief/41
http://stemteachingtools.org/pd/sessionb

SEP Developing and Using Models

- Construct a model that shows how the parts of the water cycle described in the scenario work together with the nitrogen cycle.
- Compare the models of the rock cycle to plate tectonics to identify both common and unique model components, relationships, and mechanisms.

SEP Constructing an explanation

- Construct an explanation discussing how weathering, erosion, and deposition work together.

CCC Stability and Change

- How was the carbon cycle affected by a sudden volcanic eruption?

CCC Cause and Effect

- What feedback loops are causing the rock cycle to be in [balance/equilibrium]?

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.

- **Analyze data** to determine that Earth's natural resources are found in the atmosphere, biosphere, land, and oceans caused by their interactions.
- **Construct an explanation** based on evidence that various physical processes Earth has undergone in the past have resulted in the *formation* of natural resources that are distributed unevenly around the planet.
- **Apply scientific reasoning** to describe the *relationship* between water, surface features, and underground formations.
- **Develop and/or revise a model** to show the *relationships* among Earth's processes (large and small) that are a result of the cycling of matter and the flow of energy within and among the planet's systems.

- **Construct an explanation** based on evidence for how the interaction of the planet's systems (microscopic to global in size) *have shaped Earth's history and will determine its future.* Examples of these changes include earthquakes, volcano, surface weathering, erosion, and deposition.
- **Develop a model** that describes the chemical and physical changes *produced by the cycling of energy* and matter through Earth's systems.