# Middle School Life Earth Science

## Essential Standards Extended Guide

## MIDDLE SCHOOL EARTH SCIENCE

### Background information about this document:

In response to requests from schools and districts for guidance on essential standards, committees of educators from around Idaho collaborated in the summer of 2024 to categorize Science standards into two groups:

1. **Essential standards** are explicitly taught, assessed multiple times, and receive targeted interventions for students who have not yet reached proficiency.
2. **Supporting standards** are taught to reinforce essential standards and may or may not be formally assessed.

This guidance helps LEAs prioritize the most critical standards, recognizing that not all standards are of equal importance. This document serves as a resource—not a mandate—to assist local efforts. Importantly, this work did not remove or revise any of the adopted Idaho Content Standards and is intended to refocus time and effort.

The committees developed instructional grouping models to demonstrate how standards can be combined into focused units. However, this is just one approach, and other combinations are possible. Educators can use this guide to begin developing scope and sequence for their instructional time and district-specific courses. It also provides a useful starting point for creating formative and summative assessments aligned with the standards.

**Guiding Information:** Instructional groups are organized in a sequential manner that starts with the entire universe/solar system and then slowly focuses in on the earth's place in the space and time of the universe/solar system and then gives focus on geoscience processes and atmospheric processes and then finishes with an emphasis on the impact that humans have on these systems.

## Instructional Grouping 1: Astronomy

| **Essential Standards**<br>**Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.** | **Supporting Standards and Content**<br>**Taught to support the learning of essential standards and may or may not be formally assessed.** |
|---|---|
| MS-ESS-1.1 Develop and use a model of the Earth-Sun-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon and seasons. | Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS-1.1)<br>This model of the solar system can explain eclipses of the Sun and the Moon. Earth's spin axis is fixed in direction over the short term but tilted relative to its orbit around the Sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS-1.1) |
| MS-ESS-1.2 Develop and use a model to describe the role of gravity in the orbital motions within galaxies and the solar system. | Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS-1.2)<br>The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. (MS-ESS-1.2, MS-ESS-1.3)<br>The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS-1.2) |
| MS-ESS-1.3 Analyze and interpret data to determine scale properties of objects in the solar system. | The solar system consists of the Sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the Sun by its gravitational pull on them. (MS-ESS-1.2, MS-ESS-1.3) |

**Further explanation:**

1. Examples of models can be physical, graphical, or conceptual.
2. Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).
3. Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects, such as relative size, distance, motions, and features. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.

**Assessment limits:**

1. Assessment does not include recalling lunar phases.
2. Assessment does not include recalling facts about properties of the planets and other solar system bodies.

## Instructional Grouping 2: Earth History

| **Essential Standards**<br>**Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.** | **Supporting Standards and Content**<br>**Taught to support the learning of essential standards and may or may not be formally assessed.** |
|---|---|
| MS-ESS-1.4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to analyze Earth's history. | The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS-1.4) |
| MS-ESS-2.2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. | 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-ESS-2.2)<br>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-ESS-2.2) |
| MS-ESS-2.3 Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. | Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (MS-ESS-2.3)<br>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. (MS-ESS-2.3) |

**Further explanation:**

1. Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or large volcanic eruptions.
2. 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 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.

3. 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). Examples of concepts include continental drift and seafloor spreading.

**Assessment limits:**

1. Assessment does not include recalling the names of specific eons, eras, periods or epochs and events within them.
2. Assessment does not include memorization of the formation of specific geographic features of Earth's surface, or the geochemical processes involved in the formation.
3. Assessment of plate tectonics should be limited to large-scale system interactions. Paleomagnetic anomalies in oceanic and continental crust are not assessed.

## Instructional Grouping 3: Geoscience Processes

| Essential Standards<br>**Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.** | Supporting Standards and Content<br>**Taught to support the learning of essential standards and may or may not be formally assessed.** |
|---|---|
| MS-ESS-2.1 Develop a model to describe the cycling of Earth's materials and the internal and external flows of energy that drive the rock cycle processes. | 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-ESS-2.1) |
| MS-ESS-3.1 Construct a scientific explanation based on evidence for how Earth's mineral, energy, and groundwater resources are unevenly distributed as a result of past and current geologic processes. | 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-ESS-3.1) |

**Further explanation:**

1. 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.
2. Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are changing as a result of depletion. 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).

**Assessment Limit:**

1. Assessment does not include the identification and naming of minerals.

## Instructional Grouping 4: Atmospheric Science

| Essential Standards<br>**Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.** | Supporting Standards and Content<br>**Taught to support the learning of essential standards and may or may not be formally assessed.** |
|---|---|
| MS-ESS-2.4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity. | Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, crystallization, percolation, and precipitation, as well as downhill flows on land. (MS-ESS-2.4)<br>Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS-2.4) |
| MS-ESS-2.5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. | 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-ESS-2.5)<br>Because these patterns are so complex, weather can only be predicted using probability. (MSESS-2.5) |
| MS-ESS-2.6 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 | Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS-2.6)<br>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-ESS-2.6)<br>The ocean exerts a major influence on weather and climate by absorbing energy from the Sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS-2.6) |

**Further explanation:**

1. 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.
2. 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 or obtained through laboratory experiments (such as with condensation and the use of barometers).

3. 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 limits:**

1. Assessment includes qualitative energy flows, not quantitative energy calculations.
2. Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.
3. Assessment does not include the dynamics of the Coriolis effect, or recalling names and locations of specific biomes.

## Instructional Grouping 5: Humans and the Environment

| **Essential Standards**<br>**Standards are to be explicitly taught, assessed more than once, and intervened upon in this cluster of standards.** | **Supporting Standards and Content**<br>**Taught to support the learning of essential standards and may or may not be formally assessed.** |
|---|---|
| MS-ESS-3.2 Analyze and interpret data on natural hazards to forecast future catastrophic events to mitigate their effects. | 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. (MSESS-3.2) |
| MS-ESS-3.3 Apply scientific practices to design a method for monitoring human activity and increasing beneficial human influences on the environment. | Human activities can positively and negatively influence the biosphere, sometimes altering natural habitats and ecosystems. (MS-ESS-3.3)<br>Technology and engineering can potentially help us best manage natural resources as populations increase. (MS-ESS-3.3, MS-ESS-3.4) |
| MS-ESS-3.4 Construct an argument based on evidence for how changes in human population and per-capita consumption of natural resources positively and negatively affect Earth's systems. | Technology and engineering can potentially help us best manage natural resources as populations increase. (MS-ESS-3.3, MS-ESS-3.4) |
| MS-ESS-3.5 Ask questions to interpret evidence of the factors that cause climate variability throughout Earth's history. | Current scientific models indicate that human activities, such as the release of greenhouse gases from fossil fuel combustion, can contribute to the present-day measured rise in Earth's mean surface temperature. Natural activities, such as changes in incoming solar radiation, also contribute to changing global temperatures. (MS-ESS-3.5) |

**Further explanation:**

1. Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions. Others, such as earthquakes, occur suddenly, and 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 mitigation strategies 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).
2. Examples of the design process include examining human interactions and designing feasible solutions that promote stewardship. Examples can include water usage (such as stream and river use, aquifer recharge, or dams and levee construction); land usage (such as urban development, agriculture,

wetland benefits, stream reclamation, or fire restoration); and pollution (such as of the air, water, or land).

3. Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of effects can include changes made to the appearance, composition, and structure of Earth’s systems as well as the rates at which they change.
4. Examples of factors include human activities (such as fossil fuel combustion and changes in land use) and natural processes (such as changes in incoming solar radiation and volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures; atmospheric levels of gases such as carbon dioxide and methane; and natural resource use.