Howard County Public School System
Curriculum for Middle School Science

GRADE 6: Earth and Space Science

Overview:

Middle school Earth science learning will equip students to address the following four ***essential questions*** as identified within the *Next Generation Science Standards*.

1. What is Earth's place in the Universe?
2. What makes up our Solar System, and how can the motion of Earth explain seasons and eclipses?
3. How do people figure out that Earth and life on Earth have changed over time?
4. How does the movement of tectonic plates impact the surface of the Earth?

The middle school Performance Expectations (PEs) in the earth sciences address these essential questions and build on PK-5 ideas and experiences. They blend Disciplinary Core Ideas (DCI) with Scientific and Engineering Practices (SEP) and Crosscutting Concepts (CCC) to support students in developing usable knowledge to explain real-world phenomena in the Earth and space sciences. In Earth Science, students regularly engage in asking scientific questions that drive their investigations and lead to increasingly sophisticated evaluation of data and their presentation. Students also have opportunities to learn and to apply engineering-specific practices such as designing solutions to identified problems. Visit the full NGSS storyline for Earth Science for more information.

Performance Expectations:

The *Next Generation Science Standards* (NGSS) are very different than previous standards documents. NGSS purposely combines the three dimensions of science learning into single, target statements for student learning. The three dimensions are: Science and Engineering Practices (SEP), Crosscutting Concepts (CCC), and Disciplinary Core Ideas (DCI). Earlier science standards treated the three dimensions as separate and distinct. This treatment led to assessment and instruction that emphasized one dimension preferentially over the others.

The combination of SEP, CCC, and DCI in each PE is not intended to limit instruction. Instead, the PEs are designed to guide assessment of student learning. The Performance Expectations for Middle School Earth Science support student learning in three, important disciplinary core ideas: Earth's Place in the Universe; Earth's Systems; Earth and Human Activity. The performance expectations for middle school Earth and Space science are below:

MS ESS 1 Earth's Place in the Universe

Students who demonstrate understanding can:

MS-ESS1-1.	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. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]
MS-ESS1-2.	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. [Clarification Statement: 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).] [*Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth*.]
MS-ESS1-3.	Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: 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. 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 Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies*.]
MS-ESS1-4.	Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: 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 or the earliest fossils of homo sapiens) 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 significant volcanic eruptions.] [*Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them*.]

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, 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-ESS2-2.	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 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 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 results 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 obtained through 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*.]

MS ESS 3 Earth and Human Activity

Students who demonstrate understanding can:

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).]
MS-ESS3-2.	Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus 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 technologies 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).]
MS-ESS3-3.	Apply scientific principles to design a method for monitoring and minimizing a human impact on

	the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]
MS-ESS3-4.	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: 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 impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]
MS-ESS3-5.	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or 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 the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

HCPSS Learning Sequence:

The learning sequence in Earth Science is organized around a series of driving questions that provide the context and motivation for learning. Within each driving question, students engage in a series of unique learning experiences that are carefully designed to immerse them in the SEPs as they construct their understanding of important concepts. These experiences are carefully sequenced so that students encounter ideas that are developmentally and cognitively appropriate. By the end of the learning experiences, students will be able to meet the NGSS performance expectations and address the driving questions.

Middle School Earth Science Grade 6 is comprised of four Driving Questions:

Driving Question 1	Driving Question 2	Driving Question 3	Driving Question 4
How do scientists work together to solve problems? *EL*	How do scientists gather and analyze information to prepare for a severe weather event? *EL*	How do scientists analyze the processes within the Earth that cause geologic activity?	How do scientists collect and analyze data that help them understand the movement of space objects?

EL indicates that Maryland Environmental Literacy Standards are included within this learning sequence.