6th Grade Earth and Space Science

Inquiry and Process Skills within the Content:

- Learn and apply safe laboratory techniques.
- Apply and analyze all components of the scientific method. (For example: Experimental Design Lab Outline and Vocabulary)
- Integrate science process skills (asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating).
- Select and use the appropriate tools and technology. (For example: calculators, computers, balance scales, microscopes, probe ware, and graduated cylinders.)
- Apply the appropriate SI measurements (metric system) in a lab setting.
- Differentiate between scientific hypothesis, theories, and laws.
- Recognize and investigate the contributions of diverse individuals in advancing science and technology.
- Develop, use, and revise models to describe, test, or predict interactions and scientific phenomena.
- Differentiate between science and engineering approaches.
- Evaluate multiple solutions based on scientifically obtained evidence.
- Recognize that scientific knowledge is refined over time as new evidence emerges.
- Identify and evaluate the sources used to support scientific statements.

Earth's Place in the Universe

Standard	Objective	Examples/Evidence Statement
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.	Students will: • Understand that substances are made from different types of atoms, which combine with one another in various ways. • Understand that atoms form molecules that range in size from two to thousands of atoms. • Understand that solids may be formed from molecules, or they may be extended structures with repeating sub units (e.g., crystals). • Develop, use and revise models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to predict and/or describe phenomena	• Emphasis is on developing models of molecules that vary in complexity. • Examples of simple molecules could include ammonia and methanol. • Examples extended structures could include sodium chloride or diamonds. • Examples of molecular-level models could include drawings, #D ball and stick structures, or computer representations showing different molecules with different types of atoms.
MS-ES S1-1. 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.	***The Universe and Its Stars*** Students will: • Recognize how the patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. ***Earth and the Solar System*** Students will: • Understand how a model of the solar system explains eclipses of the sun and the moon. • Recognize how Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. • Understand that seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. • Develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena.	• Examples of models can be physical, graphical, or conceptual.

MS-ES S1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.	***The Universe and Its Stars*** Students will: • Describe that the Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. ***Earth and the Solar System*** Students will: • Identify that 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. • Understand that the solar system appears to have formed from a disk of dust and gas, drawn together by gravity. • Develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena.	• 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).
MS-ES S1-3. Analyze and interpret data to determine scale properties of objects in the solar system.	***Earth and the Solar System*** Students will: • Explain that 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. • Analyze data to extend quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. • Define light year and use the concept to understand the scale of the universe.	• 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.
MS-ES S1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic times scale is used to organize Earth's 4.6 billion year-old history.	***The History of Planet Earth*** Students will: • Interpret rock strata as a way to organize Earth's history and geological time scale. • Analyze rock strata and the fossil record to provide relative dates vs. absolute scale. • Construct 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.	• 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 earlier evidence of life). • Examples can include the information of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.
Earth's Systems		
Standard	**Objective**	**Example/Clarification**
MS-ES S2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.	***Earth's Materials and Systems*** Students will: • Understand how 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. ***Distinguish the Roles of Water in Earth's Surface Processes*** Students will:	• 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

	• Understand how water's movements-both on the land and underground-cause weathering and erosion, which change the land's surface features and create underground formations. • Construct explanations and design solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct 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 nature operate today as they did in the past and will continue to do so in the future.	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-ES S2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. **HS.ESS1.C**	***Investigating the History of Planet and Earth*** Students will: • Explain that tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. ***Plate Tectonics and Large-Scale System Interactions*** Students will: • Analysis 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. • Extend quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena.	• 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).
MS-ES S2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.	***Recognize the Roles of Water in Earth's Surface Processes*** Students will: • Sort and classify objects by their state. • Understand how water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. • Understand how global movements of water and its changes in form are propelled by sunlight and gravity. • Develop, use, and revise models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms.	• 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).

MS-ES S2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.	***Identify the Roles of Water in Earth's Surface Processes*** Students will: • Analyze 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. ***Weather and Climate*** Students will: • Infer that weather patterns are so complex, weather can only be predicted probabilistically. • Investigate how to use multiple variables and provide evidence to support explanations or solutions. • Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.	• 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).
MS-ES S2-6. 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.	***Recognize Roles of Water in Earth's Surface Processes*** Students will: • Contrast how variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. ***Weather and Climate*** Students will: • Interpret how 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. • Explain how 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. ***Developing and Using Models*** Students will: • Describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena.	• 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.

Earth and Human Activity

Standard	Objective	Example/Clarification
MS-ES S3-1. 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.	***Identifying Natural Resources*** Students will: • Evaluate how humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. • Differentiate how resources are distributed unevenly around the planet as a result of past geologic processes. • Conclude that minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. • Construct a scientific explanation using Earth science models and representations including multiple sources of evidence and the students own experience.	• 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-ES S3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.	***Analyzing Natural Hazards*** Students will: • Examine how 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. • Use quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings.	• 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 of forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).
MS-ES S3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	***Investigating Human Impacts on Earth Systems*** Students will: • Demonstrate how human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. • Understand that typically and human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involve are engineered otherwise. • Construct explanations and design solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific principles to design an object tool, process or system.	• 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).