NCS Science Curriculum - Adopted & Approved October 2017
Revised August 2019
Grade 7

Year at a Glance

Earth History	Chemical Interactions	Weather and Water
September-Early December	Early December-February/March	March-June
MS-ESS1-4 MS-ESS2-1 MS-ESS2-2 MS-ESS2-3 MS-ESS3-1 MS-ESS3-2 MS-ESS3-3 MS-ESS3-4 MS-ESS3-5 MS-LS4-1	MS-PS1-1 MS-PS1-2 MS-PS1-3 MS-PS1-4 MS-PS1-5 MS-PS1-6 MS-PS3-3 MS-PS3-4 MS-PS3-5 MS-ETS1-1 MS-ETS1-2 MS-ETS1-3 MS-ETS1-4	MS-PS1-4 MS-PS3-3 MS-PS3-4 MS-PS3-5 MS-ESS1-1 MS-ESS2-4 MS-ESS2-5 MS-ESS2-6 MS-ESS3-2 MS-ESS3-3 MS-ESS3-4 MS-ESS3-5 MS-ETS1-1 MS-ETS1-2 MS-ETS1-3 MS-ETS1-4

Standards are listed in a numerical order only and may be taught in any order within the unit.

*The standards listed in red are the Disciplinary Core ideas as they relate to the Performance Expectations within the units.

NOTE: The Science and Engineering Practices are interwoven and should be addressed throughout the year in as many different units and tasks as possible in order to stress the natural connections that exist among mathematical concepts.

7th grade SCIENCE NGSS Instructional Scope and Sequence

Science Area	Earth	Chemical/Physical	Life
Unit Title	Earth History	Chemical Interactions	Weather and Water
Duration	Approximately 60 – 45-50 minute class periods or 30 – 90-100 minute class periods	Approximately 60 – 45-50 minute class periods or 30 – 90-100 minute class periods	Approximately 65 – 45-50 minute class periods or 32 – 90-100 minute class periods

- The units may be taught in any order.
- FOSS Kits are being utilized as the primary instructional material. Other materials, such as, but not limited to, websites, videos, reference books, non-fiction and fictional books, textbooks, and other resources may be utilized as instructional material.

- Standards are listed in numerical order only and may be taught in any order within the unit.

- The Science and Engineering Practices are interwoven and should be addressed throughout the year in as many different units and tasks as possible in order to stress the natural connection that exists among mathematical concepts.

- Cross cutting concepts are utilized throughout the units in no set order, but are there so that the students may realize that skills are interwoven in many disciplines.

Chemical/Physical Science

Performance Expectations:

MS-PS1-1. **Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.]

MS-PS1-2 **Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred**. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.]

MS-PS1-3. **Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.]

MS-PS1-4. **Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

MS-PS1-5. **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.]

MS-PS1-6. **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.*** [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride

MS-PS3-3. **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*** [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup]

MS-PS3-4. **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.]

MS-PS3-5. **Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.** [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object

MS-ETS1-1 **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**

MS-ETS 1.2	**Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**
MS-ETS 1.3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS 1.4	**Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**

Science and Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concept:
Developing and Using Models . ● Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) ● Develop a model to describe unobservable mechanisms. (MS-PS1-5) **Analyzing and Interpreting Data** ● Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) **Constructing Explanations and Designing Solutions** ● Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6) - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ● Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ● Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5) **Obtaining, Evaluating, and Communicating Information** ● Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence. (MS-PS1-3) **Developing and Using Models** ● Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Planning and Carrying Out Investigations** ● Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded,	**PS1.A: Structure and Properties of Matter** ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* **PS1.B: Chemical Reactions** ● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-5) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* ● The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) ● Some chemical reactions release energy, others store energy. (MS-PS1-6) **PS3.A: Definitions of Energy** ● The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between	**Patterns** ● Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) Energy and Matter ● Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5) ● The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6) ● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5) ● The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3) **Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) **Scale, Proportion, and Quantity** ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1) ● Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4) **Structure and Function** ● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3) **Systems and System Models** ● Models can be used to represent systems and their interactions – such as inputs, processes,

and how many data are needed to support a claim. (MS-PS3-4) **Analyzing and Interpreting Data** • Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1) **Constructing Explanations and Designing Solutions** • Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Engaging in Argument from Evidence** • Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5) - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3-4),(MS-PS3-5)	two objects. *(secondary to MS-PS1-4)* • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depends on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)* • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) • Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4) **PS3.B: Conservation of Energy and Energy Transfer** • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) • The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) \\ **PS3.C: Relationship Between Energy and Forces**	and outputs – and energy and matter flows within systems. (MS-PS3-2) - ***Connections to Engineering,Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3) **Influence of Science, Engineering and Technology on Society and the Natural World** • The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)

	• When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) **ETS1.A: Defining and Delimiting an Engineering Problem** • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. *(secondary to MS-PS3-3)* **ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)* **ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)* • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(secondary to MS-PS1-6)*	

Connections to CCSS:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.*(MS-PS1-2)*

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)

RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-2),*(MS-PS1-5)*

WHST.6-8.1 Write arguments focused on discipline content. *(MS-PS3-5)*

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)

WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)

SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS3-2)*

Mathematics-

MP.2 Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5)

MP.4 Model with mathematics. (MS-PS1-5)

6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),*(MS-PS3-5)*

6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b $\neq$ 0, and use rate language in the context of a ratio relationship. *(MS-PS3-1)*

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-2)*,(MS-PS1-5)

7.RP.A.2 Recognize and represent proportional relationships between quantities. (MS-PS3-1),*(MS-PS3-5)*

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)

8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. *(MS-PS3-1)*

8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),*(MS-PS3-5)*

6.NS.C.5 Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)

8.EE.A.2 Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. *(MS-PS3-1)*

8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),*(MS-PS3-5)*

6.SP.B.4 Display numerical data in plots on a number line, including dot plots, histograms, and box plots. *(MS-PS1-2)*

6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-PS1-2)
Essential Questions: What is matter made of? In what ways and under what circumstances does matter change? How do we know? How do substances combine or change (react) to make new substances? How can a standard thermometer be used to tell you how particles are behaving? How can we tell if a chemical or physical reaction took place?
Learning Objectives: Students will be able to: **1. Develop models to describe the atomic composition of simple molecules and extended structures.** **2. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.** **3. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.** **4. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.** **5. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.** **6. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.** **7. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** **8. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.**
Assessment: **Assessment may include, but not be limited to:** **Student participation in classroom discussions, labs, projects, etc. As observed by the teaching staff; quizzes, labs, projects, worksheets, computer simulations, tests, benchmark assessments, claim-evidence-reasoning paragraphs, lab reports, and interactive science notebook.**

Earth Science

Performance Expectations:

Students who demonstrate understanding can:

MS-ESS1-4. **Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to 4.6-billion-year-old history.** [Clarification Statement: Emphasis is on how analyses of rock formations and the foss used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range fro (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the e life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of part organisms, or significant volcanic eruptions.]

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.]

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).]

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 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) 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 met of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]
MS-LS4-1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.]

Science and Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concept:
Developing and Using Models ● Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2) **Analyzing and Interpreting Data** ● Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3) **Constructing Explanations and Designing Solutions** ● 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. (MS-ESS1-4)	**ESS1.A: The Universe and Its Stars** ● 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-ESS1-1) ● Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2) **ESS1.B: Earth and 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-ESS1-2),(MS-ESS1-3) ● 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-ESS1-1) ● The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2) **ESS1.C: The History of Planet Earth** ● 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-ESS1-4)	**Patterns** ● Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1) **Scale, Proportion, and Quantity** ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4) **Systems and System Models** ● Models can be used to represent systems and their interactions. (MS-ESS1-2) ***Connections to Engineering,Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** ● Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3) ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ● Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1),(MS-ESS1-2)

Connections to CCSS:

ELA/Literacy -

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3),(MS-ESS1-4)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS1-4)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-ESS1-1),(MS-ESS1-2)*

Mathematics -

MP.2	Reason abstractly and quantitatively. (MS-ESS1-3)
MP.4	Model with mathematics. *(MS-ESS1-1),(MS-ESS1-2)*
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS1-1),(MS-ESS1-2)*,(MS-ESS1-3)
7.RP.A.2	Recognize and represent proportional relationships between quantities. *(MS-ESS1-1),(MS-ESS1-2)*,(MS-ESS1-3)

6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS1-2),(MS-ESS1-4)*
7.EE.B.6	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS1-2),(MS-ESS1-4)*

Essential Questions:

If no one was there, how do we know the Earth's history?

What provides the forces that drive Earth's systems?

Learning Objectives:

Students will be able to:

1. **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.**
2. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
3. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
4. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
5. **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.**
6. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
7. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
8. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
9. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
10. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

Assessment:

Assessment may include, but not be limited to:
Student participation in classroom discussions, labs, projects, etc. As observed by the teaching staff; quizzes, labs, projects, worksheets, computer simulations, tests, benchmark assessments, claim-evidence-reasoning paragraphs, lab reports, and interactive science notebook.

NGSS Instructional Sequence

Unit 3 Weather and Water		
Performance Expectations:		
Engineering, Technology, and the Applications of Science	**Earth and Space Sciences**	**Physical Sciences**
MS-ETS1-1 MS-ETS1-2 MS-ETS1-3 MS-ETS1-4	MS-ESS1-1 MS-ESS2-4 MS-ESS2-5 MS-ESS2-6 MS-ESS3-2 MS-ESS3-3 MS-ESS3-4 MS-ESS3-5	MS-PS1-4 MS-PS3-3 MS-PS3-4 MS-PS3-5

Essential Question(s):

- What is weather?
- What is air?
- What is atmosphere?
- How does pressure affect air?
- What happens when two areas of air have different pressures?
- What is the relationship between layering of fluids and density?
- How does heat affect density of fluids?
- How do gases flow in the atmosphere?
- How does weather differ between locations?
- How does the Sun affect the temperature of locations on Earth?
- What factors affect the surface temperature on Earth?
- How does energy move through materials?
- How can you reduce energy transfer to or from a model home?
- How can we design a more efficient way to decrease energy transfer between a model home and the environment?
- How does the atmosphere heat up?
- How does energy from the Sun affect wind on Earth?
- What affects the direction of global winds?
- Is there water vapor in the air?
- How does energy transfer when water changes phases?
- What causes clouds to form?
- What is the water cycle?
- What affects the direction that ocean water flows?
- How does the ocean affect climate on land?
- How have climates changed over time?
- How do greenhouse gases in the atmosphere affect Earth's temperature?
- What are the effects of a slight rise in global temperatures?
- What information can you get from a weather map?
- What is the difference between weather and climate?

Terms:
Air, air pressure, atmosphere, compress, exosphere, expand, forecast, humidity, mass, matter, mesosphere, meteorologist, meteorology
Particle, permanent gas, precipitation, prediction, pressure, severe weather, state, stratosphere, temperature, thermosphere, troposphere, variable gas, weather, weight, wind, atmospheric pressure, bar, Barometer, density, equilibrium, isobar, kinetic energy, millibar (mb), convection, convection cell, energy transfer, fluid, model, absorb, climatologist, climatology, differential heating, evidence, heat, latitude, radiant energy, radiation, ray, solar angle, thermal energy, conduction, constraint, criterion, engineering problem, insulation, air mass, Coriolis effect, jet stream, land breeze, prevailing wind, sea breeze, condensation, condensation nuclei, dew point, evaporation, precipitation, saturated, transpiration, El Niño, groundwater, gyre, ocean current, salinity, water cycle, carbon dioxide, carbon sequestration, climate change, emission, global warming, greenhouse effect, greenhouse gas, ice core, infrared,
Paleoclimatology, pollutant, cold front, warm front

Science and Engineering Practices:

1. Asking questions and defining problems
   - Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.
   - Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
   - Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.
2. Developing and using models
   - Develop and/or use a model to predict and/or describe phenomena.
   - Develop a model to describe unobservable mechanisms.
   - Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales.
3. Planning and carrying out investigations
   - Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
   - Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
   - Collect data to serve as the basis for evidence to answer scientific

Disciplinary Core Ideas Addressed:

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- 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.
- Because these patterns are so complex, weather can only be predicted probabilistically.
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
- 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.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- 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

Crosscutting Concept

1. **Patterns:** Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
   - Patterns in rates of change and other numerical relationships can provide information about natural and human-designed systems.
   - Patterns can be used to identify cause-and-effect relationships.
   - Graphs, charts, and images can be used to identify patterns in data.
2. **Cause and effect:** 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 .
   - Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. Scale, proportion, and quantity: In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
   - Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.
   - Proportional relationships among different types of quantities provide information about the magnitude of properties and processes.
   - Scientific relationships can be represented through the use of algebraic expressions and equations.
3. **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.
   - Models can be used to represent systems and their interactions— such as inputs, processes, and outputs—and energy, matter, and information flows within systems.

   Energy and matter: Tracking energy and matter flows into, out of, and within systems helps to understand the system's behavior.
   - Within a natural (or designed) system, the transfer of energy drives the motion and/or cycling of matter.

questions or test design solutions under a range of conditions. 4. Analyzing and interpreting data • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. • Use graphical displays (e.g., maps, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships. • Analyze and interpret data to provide evidence for phenomena. • Analyze and interpret data to determine similarities and differences in findings. • Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success. 5. Using mathematics and computational thinking • Use mathematical representations to describe and/or support scientific conclusions and design solutions. • Create algorithms (a series of ordered steps) to solve a problem. • Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems. 6. Constructing explanations and designing solutions • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. • 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. • Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. 7. Engaging in argument from evidence • Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. 8. Obtaining, evaluating, and communicating information • Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe	differential intensity of sunlight on different areas of Earth across the year. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge likely to limit possible solutions. • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • Models of all kinds are important for testing solutions. • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. • Global movements of water and its changes in form are propelled by sunlight and gravity. • 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. • Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	• The transfer of energy can be tracked as energy flows through a designed or natural system. 4. **Structure and function:** The way an object is shaped or structured determines many of its properties and its functions. • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. 5. **Stability and change:** For both designed and natural systems, conditions that affect stability and factors that controls rates of change are critical elements to consider and understand. • Stability might be disturbed either by sudden events or gradual changes that accumulate over time

patterns in and/or evidence about the natural and designed world(s). • Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.		

Connections to CCSS:

Reading—Literacy in Science and Technical Subjects

1. Cite specific textual evidence to support analysis of science and technical texts.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases.
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
9. Compare and contrast the information gained from experiments, video, or multimedia sources with that gained from reading a text on the same topic.
10. Read and comprehend science/technical texts in grades 6–8 text independently and proficiently.

Speaking and Listening

1. Engage effectively in a range of collaborative discussions with diverse partners, building on others' ideas and expressing their own clearly.
2. Interpret and analyze information presented in diverse media and formats and evaluate the motives behind its presentation.
3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
5. Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
9. Draw evidence from informational texts to support analysis, reflection, and research.
3. Delineate a speaker's argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.
4. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Writing—Literacy in Science and Technical Subjects

5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
7. Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
8. Gather relevant information from multiple print and digital sources, using search terms effectively.
9. Draw evidence from informational texts to support analysis, reflection, and research.

Language

5. Demonstrate understanding of word relationships and nuances in word meaning
6. Acquire and use academic and domain-specific words and phrases.

Assessments:

- Entry Level Survey (Benchmark assessment)
- I-Checks: Investigation 1, Investigation 2, Investigation 3, Investigation 4, Investigation 5-6, Investigation 7-8, Investigation 9
- Posttest
- Embedded Assessments