Science Scope and Sequence ***Middle School***

The Scope and Sequence document represents an articulation of what students should know and be able to do. The document supports teachers in knowing how to help students achieve the goals of the standards and to understand each standard conceptually. It should be used as a tool to assist in planning and implementing a high quality instructional program.

- The Units provides a snapshot of instruction across a year.
- The unpacking section contains rich information and examples of what the standard and benchmarks mean.
- The progressions provides valuable information for pre assessment as well as information on what follows.

SCIENCE STANDARDS

Standard 1: Life Science

Learners will understand the basic concepts and principles of life science.

1. *Structure and Function*
2. *Growth and Development of Organisms*
3. *Organization for Matter and Energy Flow in Organisms*
4. *Information Processing*
5. *Interdependent Relationships in Ecosystems*
6. *Cycle of Matter and Energy Transfer in Ecosystems*
7. *Ecosystem Dynamics, Functioning, and Resilience*
8. *Biodiversity and Humans*
9. *Growth and Development of Organisms*
10. *Inheritance of Traits*
11. *Evidence of Common Ancestry and Diversity*
12. *Natural Selection*
13. *Adaptation*

Standard 2: Physical Science

Learners will develop an understanding of concepts, models, theories, universal principles, and the facts that explain the physical world.

1. *Structure and Properties of Matter*
2. *Chemical Reactions*
3. *Forces and Motion*
4. *Types of Interactions*
5. *Definitions of Energy*
6. *Conservation of Energy and Energy Transfer*
7. *Relationship between Energy and Forces*
8. *Energy in Chemical Processes and Everyday Life*
9. *Wave Properties*
10. *Electromagnetic Radiation*
11. *Information Technologies and Radiation*

Standard 3: Earth & Space Science

Learners will gain an understanding of the origin, evolution and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth.

1. *The Universe and its Stars*
2. *Earth and the Solar System*
3. *The History of the Planet Earth*
4. *Earth's Materials and Systems*
5. *Plate Tectonics and Large Scale System Interactions*
6. *The Roles of Water in Earth's Surface Processes*
7. *Weather and Climate*
8. *Natural Resources*
9. *Natural Hazards*
10. *Human Impacts on Earth Systems*
11. *Global Climate Change*

Standard 4: Scientific Inquiry and Critical Thinking

Learners will demonstrate an understanding of the nature of scientific inquiry

1. *Science and Engineering Practices*
    - *Asking Questions and Defining Problems*

- *Developing and Using Models*
- *Planning and Carrying Out Investigations*
- *Analyzing and Interpreting Data*
- *Using Mathematics and Computational Thinking*
- *Constructing Explanations and Designing Solutions*
- *Engaging in Argument from Evidence*
- *Obtaining, Evaluating and Communicating Information*

2. Engineering design

Standard 5: History & Nature of Science
Learners will demonstrate an understanding of the history of science and the evolvement of scientific knowledge

Grade 6 Units

Wonderful World of Science	Hot Matter	Cells and Inheritance	Weather and Climate

Grade 7 Units

Matter Matters	Matter Matters to Living Things	Matter Matters to Humans	Living Earth	Dynamic Planet

Grade 8 Units

Energy Forces and Interactions	History of the Earth And Space systems	Natural Selection	Waves and Electromagnetic radiation

Standard 1: Life Science Learners will understand the basic concepts and principles of life science			
Benchmarks LS	**Performance Indicators**		
	Grade 6	**Grade 7**	**Grade 8**
	Structure and Function		
1.1 (LS1-1): Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells	Do: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells. Know: All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1).		
1.2 (LS1-2): Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function	Do: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. Know: Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2).		

	Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.		
1.3 (LS1-3): Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells	Do: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems. States and records ideas on familiar topics relevant to their lives using simple sentences and the present tense or the near future. Know: In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3). Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is		

	limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.Ability to present simple personal information on familiar topics.		
	Growth and Development of Organisms		
1.4(LS1-4): Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively			Do: 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 Know: The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.
1.5(LS1-5): Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms	Do: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary:		

	Know: Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5) Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.		
	Organization for Matter and Energy Flow in Organisms		
1.6(LS1-6): Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms		Do: Emphasis is on tracing movement of matter and flow of energy. Know: ♦ Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6) ♦ The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6) ♦ Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react	

		with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7) Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.	
1.7(LS1-7): Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism		Do: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released. Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration. Know: ♦ Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7) ♦ Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)	
	Information Processing		
1.8(LS1-8): Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for	Know: Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain,		

immediate behavior or storage as memories	resulting in immediate behaviors or memories. (MS-LS1-8) Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.		
	Interdependent Relationships in Ecosystems		
1.9(LS2-1): Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem		Do: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources. Know: • Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1) • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) • Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)	
1.10(LS2-2): Construct an explanation that predicts patterns of interactions among		Do: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of	

organisms across multiple ecosystems		types of interactions could include competitive, predatory, and mutually beneficial Know: Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)	
	Cycle of Matter and Energy Transfer in Ecosystems		
1.10(LS2-2): Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems		Do: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial Know: Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)	

	Cycle of Matter and Energy Transfer in Ecosystems		
1.11(LS2-3): Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem		Do: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system. Know: Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.	
	Ecosystem Dynamics, Functioning, and Resilience		
1.12(LS2-4): Construct an argument, supported by empirical evidence, that changes to physical or biological components of an ecosystem affect populations		Do: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems. Know: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological	Do: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures Know: Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of

		component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)	evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
1.13(LS2-5): Evaluate competing design solutions for maintaining biodiversity and ecosystem services		Do: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations. Know: • Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)	
	Biodiversity and Humans		
Evaluate competing design solutions for maintaining biodiversity and ecosystem services		Do: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations. Know:	

		• Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) • Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (secondary to MS-LS2-5)	
	Growth and Development of Organisms		
Relate to LS3-2			
	Inheritance of Traits		
1.14 (LS3-1): Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism	Removed from Grade 6 and moved to Grade 8		Does this need revising or updating? Do: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins. Know: Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and

			functions of the organism and thereby change traits. (MS-LS3-1) Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.
1.15(LS3-2): Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variations	REMOVED		Take out Gr 6 Insert for Gr 8
	Evidence of Common Ancestry and Diversity		
1.16(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			Do: 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. Know: The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) Assessment Boundary:

			Assessment does not include the names of individual species or geological eras in the fossil record
1.17(LS4-2): Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships			Do: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures Know: Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
1.18(LS4-3): Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy			Do: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. Know: Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3) Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development
	Natural Selection		
1.19(LS4-4):			Do:

Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment			Emphasis is on using simple probability statements and proportional reasoning to construct explanations. Know: Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)
1.20(LS4-5): Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms			Do: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries Know: In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)
	Adaptation		
1.21(LS4-6): Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time			Do: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] Know: Adaptation by natural selection acting over generations is one important process by

			which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6) Assessment Boundary: Assessment does not include Hardy Weinberg calculations.

Standard 2: Physical Science **Learners will develop an understanding of concepts, models, theories, universal principles, and the facts that explain the physical world**			
Benchmarks LS	**Performance Indicators**		
	Grade 6	**Grade 7**	**Grade 8**
	Structure and Properties of Matter		
2.1 (PS1-1): Develop models to describe the atomic composition of simple molecules and extended structures		Do: 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. Know: • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form	

		molecules that range in size from two to thousands of atoms. (MS-PS1-1) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.	
2.2 (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		Do: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride. Know: • 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),(MS-PS1-3) • 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-PS1-3),(MS-PS1-5) Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.	
2.3 (PS1-3):		Do:	

Gather and make sense of information to describe that synthetic materials come from natural sources and impact society		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. Know: • 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),(MS-PS1-3) • 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-PS1-3),(MS-PS1-5) Assessment Boundary: Assessment is limited to qualitative information.	
2.4 (PS1 -4): Develop a model that predicts and describes changes in particle motion, temperature ad state of a pure substance when thermal energy is added or removed	Insert needed due to change from grade 7	Removed and moved to Grade 6	
	Chemical Reactions		

2.2 (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		Do: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride. Know: •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-PS1-3),(MS-PS1-5) •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),(MS-PS1-3) Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.	
2.5 (PS1-5): Develop and use a model to describe hoe the total number of atoms does not change in a chemical reaction		Do: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms. Know: • 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-PS1-3),(MS-PS1-5)	

		• The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.	
2.6 (PS1-6): Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes		Do: 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. Know: • Some chemical reactions release energy, others store energy. (MS-PS1-6) • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (secondary to MS-PS1-6) • 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) Assessment Boundary: Assessment is limited to the criteria of amount, time, and	

		temperature of substance in testing the device.	
	Forces and Motion		
2.7 (PS2-1): Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects			Do: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle. Know: For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1) Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension
2.8 (PS2-2): Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object			Do: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units. Know: • The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) • All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and

			arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2) Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry
	Types of Interactions		
2.9 (PS2-3): Ask questions about data to determine the factors that affect the strength of electric and magnetic forces			Do: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor. Know: Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.
2.10 (PS2-4): Construct and preserve arguments using evidence to support the claim that gravitational interactions			Do: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the

are attractive and depend on the masses of interacting objects			Sun, and orbital periods of objects within the solar system. Know: Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) Assessment Boundary: Assessment does not include Newton’s Law of Gravitation or Kepler’s Laws
2.11(PS2-5): Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact			Do: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations. Know: Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5) Assessment Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.
	Definitions of Energy		
2.12(PS3-1): Construct and interpret graphical displays of data to describe the relationships of kinetic			Do: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks

energy to the mass of an object and to the speed of an object			downhill, and getting hit by a wiffle ball versus a tennis ball Know: 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)
2.13(PS3-2): Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system			Do: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. Know: 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) Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions
	Conservation of Energy and Energy Transfer		
2.14(PS3-3): Apply scientific principles to design, construct, and	Do: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup. [Assessment Boundary:		

test a device that either minimizes of maximizes thermal energy transfer	Assessment does not include calculating the total amount of thermal energy transferred. Know: ♦ 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) ♦ Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) ♦ 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) ♦ 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) Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.		
2.15(PS3-4): Plan an investigation to determine the	Do: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same		

relationships among the energy transferred, they type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample	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. Know: • 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) • 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) Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.		
2.16(PS3-5): Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object	Do: 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. Know: When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)		

	Assessment Boundary: Assessment does not include calculations of energy.		
	Relationship between Energy and Forces		
2.13 (PS3-2): Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system			Do: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems. Know: 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 Assessment Boundary Assessment is limited to two objects and electric, magnetic, and gravitational
	Energy in Chemical Processes and Everyday Life		
Relate to LS1-6 & 1-7			
	Wave Properties		
2.17(PS4-1): Use mathematical representations to describe a simple model			Do: Emphasis is on describing waves with both qualitative and quantitative thinking. Know:

for waves that includes how the amplitude of a wave is related to the energy in a wave			A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.
2.18(PS4-2): Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials			Do: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions. Know: • A sound wave needs a medium through which it is transmitted. (MS-PS4-2)When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) • The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) • A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) • However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.
	Information Technologies and Instrumentation		
2.19(PS4-3):			2.19(PS4-3) Do:

			Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen. Know: Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3) Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device

Standard 3: Earth & Space Science **Learners will gain an understanding of the origin, evolution and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth**			
Benchmarks LS	**Performance Indicators**		
	Grade 6	**Grade 7**	**Grade 8**
	The Universe and it's Stars		
3.1(ESS1-1): Develop models to describe the atomic composition of simple molecules and extended structures			Do: Examples of models can be physical, graphical, or conceptual. Know: ♦ 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) ♦ 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) Do: 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. Know: 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) Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies
	Earth and the Solar System		

3.1(ESS1-1): Develop and use a model of the Earth-sun-moon to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons			Do: Examples of models can be physical, graphical, or conceptual. Know: 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) 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)
3.2(ESS1-2): Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system			Do: 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 their school or state). Know: Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)The solar system appears to have formed from a

			disk of dust and gas, drawn together by gravity. (MS-ESS1-2) Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth
3.3(ESS1-3): Analyze and interpret data to determine scale properties of objects in the solar system			Do: 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. Know: 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) Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies
	History of the Planet Earth		
3.4(ESS1-4):			Do:

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			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. Know: 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) Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them
	Earth's Materials and Systems		
3.5(ESS2-1): Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process		Know: Do: 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. Know	

		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-ESS2-1) Assessment Boundary: Assessment does not include the identification and naming of minerals.	
3.6(ESS2-2): Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales		Do: 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. Know: • 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-ESS2-2)	

		• 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-ESS2-2)	
	Plate Tectonics and Large-Scale System Interactions		
3.7(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		Do: 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). Know: 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-ESS2-3) Assessment Boundary: Paleomagnetic anomalies in oceanic	
3.8(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	Do: 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. Know: • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)		

	• Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) • Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.		
	The Roles of Water in Earth's Surface Processes		
3.6(ESS2-2): Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales		Do: 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. Know: • 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-ESS2-2)	

		• 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-ESS2-2)	
3.8(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	Do: 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. Know: ♦ Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) ♦ Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4) Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)		
3.9(ESS2-5): Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions	Do: 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. Know: 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-ESS2-5) 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.		
3.10(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	Do: 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. Know: • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)		

	• 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-ESS2-6) • 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-ESS2-6) Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.		
	Weather and Climate		
3.9(ESS2-5): Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions	Do: 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. Know: 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-ESS2-5) Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5) 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.		
3.10(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	Do: 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. Know: ♦ Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) ♦ 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-ESS2-6) ♦ 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-ESS2-6) Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.		
	Natural Resources		
3.11(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		Know: Do: 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). Know: 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-ESS3-1)	
	Natural Hazards		
3.12(ESS3-2): Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment		Do: 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). Know: 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. (MS-ESS3-2)	
	Humans and Impacts on Earth Systems		
3.13(ESS3-3): Apply scientific principles to design a method for monitoring and minimizing	Do: 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.		

a human impact on the environment	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). Know: 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. (MS-ESS3-3)		
3.14(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		Insert needed (moved from Grade 8)	Removed from Gr 8
	Global Climate Change		
3.15(ESS3-5): Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century	Do: 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. Know: Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)		

Standard 3: Earth & Space Science **Learners will gain an understanding of the origin, evolution and structure of the universe and will gain an understanding of the structure, dynamics, and geophysical systems of the earth**			
Benchmarks **LS**	**Performance Indicators**		
	Grade 6	**Grade 7**	**Grade 8**
	Science and Engineering Practices		
1. Asking Questions and Defining Problems	Ask questions: ♦ that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. ♦ to identify and/or clarify evidence and/or the premise(s) of an argument. ♦ to determine relationships between independent and dependent variables and relationships in models. ♦ to clarify and/or refine a model, an explanation, or an engineering problem. ♦ that require sufficient and appropriate empirical evidence to answer.		

	♦ 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. ♦ that challenge the premise(s) of an argument or the interpretation of a data set. ♦ 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. Relate explicitly to MS-PS2-3, MS-ESS3-5, MS-ETS1-1
2. Developing and Using Models	♦ Evaluate limitations of a model for a proposed object or tool. ♦ Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. ♦ Use and/or develop a model of simple systems with uncertain and less predictable factors. ♦ Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. ♦ 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. Relate explicitly to MS-PS1-1, MS-PS1-4, MS-PS1-5, MS-PS3-2, MS-PS4-2, MS-LS1-2, MS-LS1-7, MS-LS2-3, MS-LS3-1, MS-LS3-2, MS-ESS1-1, MS-ESS1-2, MS-ESS2-1, MS-ESS2-4, MS-ESS2-6, MS-ETS1-4
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. ♦ Evaluate the accuracy of various methods for collecting data. ♦ 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. ♦ Collect data about the performance of a proposed object, tool, process or system under a range of conditions. Relate explicitly to MS-PS2-2, MS-PS2-5, MS-PS3-4, MS-LS1-1, MS-ESS2-5

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. ♦ Distinguish between causal and correlational relationships in data. ♦ Analyze and interpret data to provide evidence for phenomena. ♦ Apply concepts of statistics and probability (including mean, median, mode, and variability) to analyze and characterize data, using digital tools when feasible. ♦ Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trials). ♦ 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. Relate explicitly to MS-PS1-2, MS-PS3-1, MS-LS2-1, MS-LS4-1, MS-LS4-3, MS-ESS1-2, MS-ESS2-3, MS-ESS3-2, MS-ETS1-3
5. Using Mathematics and Computational Thinking	Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. 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. ♦ Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. Use digital tools (e.g., computers) to analyze very large data sets for patterns and trends. ♦ 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. ♦ Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem. Relate explicitly to MS-PS4-1, MS-LS4-6
6. Constructing Explanations and	♦ Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. ♦ Construct an explanation using models or representations.

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. ♦ Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events. ♦ Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion. ♦ 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. ♦ Optimize performance of a design by prioritizing Relate explicitly to MS-PS1-6, MS-PS2-1, MS-PS3-3, MS-LS1-5, MS-LS1-6, MS-LS2-2, MS-ESS1-4, MS-ESS2-2, MS-ESS3-1, MS-ESS3-3
7. Engaging in Argument from Evidence	♦ Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. ♦ Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. ♦ Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. ♦ Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. ♦ Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. ♦ Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. ♦ Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints. ♦ Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. Relate explicitly to MS-PS2-4, MS-PS3-5, MS-LS1-3, MS-LS1-4, MS-LS2-4, MS-LS2-5, MS-ESS3-4, MS-ETS1-2

8.	♦ Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe 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. ♦ 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 not supported by evidence. ♦ Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. ♦ Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations Relate explicitly to MS-PS1-3, MS-PS4-3, MS-LS1-8, MS-LS4-5
	Engineering Design
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 ay limit possible solutions.	♦ 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 are likely to limit possible solutions. (MS-ETS1-1)
MS-ETS1-2. Evaluate competing design solutions sing a systematic rocess to determine how ell they meet the criteria and constraints of the problem.	♦ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify	♦ There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) ♦ Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)

the best characteristics of each that can be combined into a new solution to better meet the criteria for success.	♦ 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. (MS-ETS1-3)
MS-ETS1-4. 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.	♦ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ♦ Models of all kinds are important for testing solutions. (MS-ETS1-4) ♦ 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. (MS-ETS1-4)

Standard 5: History & Nature of Science **Learners will demonstrate an understanding of the history of science and the evolvement of scientific knowledge**			
Benchmarks	**Performance Indicators**		
	Grade 6	**Grade 7**	**Grade 8**
Scientific Investigations Use a Variety of Methods	Science investigations use a variety of methods and tools to make measurements and observations. Science investigations are guided by a set of values to ensure accuracy of measurements, observations, and objectivity of findings. Science depends on evaluating proposed explanations. Scientific values function as criteria in distinguishing between science and non-science.		
Scientific Knowledge is Based on Empirical Evidence	Science knowledge is based upon logical and conceptual connections between evidence and explanations. Science disciplines share common rules of obtaining and evaluating empirical evidence.		
Scientific Knowledge is Open to Revision in Light of New Evidence	Scientific explanations are subject to revision and improvement in light of new evidence. The certainty and durability of science findings varies.		

	Science findings are frequently revised and/or reinterpreted based on new evidence.
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena	Theories are explanations for observable phenomena. Science theories are based on a body of evidence developed over time. Laws are regularities or mathematical descriptions of natural phenomena. A hypothesis is used by scientists as an idea that may contribute important new knowledge for the evaluation of a scientific theory. The term "theory" as used in science is very different from the common use outside of science.
Science is a Way of Knowing	Science is both a body of knowledge and the processes and practices used to add to that body of knowledge. Science knowledge is cumulative and many people, from many generations and nations, have contributed to science knowledge. Science is a way of knowing used by many people, not just scientists.
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. Science carefully considers and evaluates anomalies in data and evidence.
Science is a Human Endeavor	Men and women from different social, cultural, and ethnic backgrounds work as scientists and engineers. Scientists and engineers rely on human qualities such as persistence, precision, reasoning, logic, imagination and creativity. Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism and openness to new ideas. Advances in technology influence the progress of science and science has influenced advances in technology.
Science Addresses Questions About the Natural and Material World.	Scientific knowledge is constrained by human capacity, technology, and materials. Science limits its explanations to systems that lend themselves to observation and empirical evidence. Science knowledge can describe consequences of actions but is not responsible for society's decisions.