Grade 6

DBR-6-MS-PS1-1

MATTER AND ITS INTERACTIONS

Performance Expectation	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 carbon dioxide and water. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3-D models, or computer representations showing different molecules with different types of atoms.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts

1. Asking questions and defining problems **2. Developing and using models:** Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**STRUCTURE AND PROPERTIES OF MATTER** 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.A.a) Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS.PS1A.e)	**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.

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Expectation	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
Clarification Statement	Examples of practical problems could include reducing the effects of impact of two objects such as two cars hitting each other, an object hitting a stationary object, or a meteor hitting a spacecraft.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking **6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in 6–8 builds on K–5 experiences and progresses to include designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system. 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**FORCES AND MOTION** 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.PS2A.a) **DEVELOPING POSSIBLE SOLUTIONS** A solution needs to be tested,to prove the validity of the design 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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. Models of all kinds are important for testing solutions (MS.ETS1B.a)	**SYSTEMS AND SYSTEM MODELS** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Expectation	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.
Clarification Statement	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) in one dimension to a given frame of reference, or specification of units.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. **Planning and carrying out investigations:** Planning and carrying out investigations to answer questions (science) or test solutions (engineering) to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • 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. 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing Solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**FORCES AND MOTION** 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 (acceleration) (MS.PS2A.b) 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.PS2A.c) The motion of an object is dependent upon the reference frame of the observer. The reference frame must be shared when discussing the motion of an object. (MS.PS2A.d)	**STABILITY AND CHANGE** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales, including atomic scales.

Grade 6

DBR-6-MS-PS2-3

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Expectation	Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.
Clarification Statement	Questions about data might require quantitative answers related to proportional reasoning and algebraic thinking. Examples of devices that use electric and magnetic forces could include electromagnets. 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.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. **Asking questions and defining problems:** Asking questions (science) and defining problems (engineering) in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and making models. • 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. 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**TYPES OF INTERACTIONS** Electric and magnetic (electromagnetic) forces can be attractive (opposite charges) or repulsive (like charges), have polar charges (north and south poles) and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS.PS2B.a)	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Grade 6

DBR-6-MS-PS2-4

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Expectation	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
Clarification Statement	Examples of evidence for arguments could include data generated from simulations or digital tools and charts displaying mass, strength of interaction, distance from the Sun, or orbital periods of objects within the solar system, not necessarily including Newton's Law of Gravitation or Kepler's Laws.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. **Engaging in argument from evidence:** Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • 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. 8. Obtaining, evaluating, and communicating information	**TYPES OF INTERACTIONS** 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.PS2B.b)	**SYSTEMS AND SYSTEM MODELS** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

Grade 6

DBR-6-MS-PS2-5

MOTION AND STABILITY: FORCES AND INTERACTIONS

Performance Expectation	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.
Clarification Statement	Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, or electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations designed to provide qualitative evidence for the existence of fields.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. **Planning and carrying out investigations:** Planning and carrying out investigations to answer questions (science) or test solutions (engineering) to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**TYPES OF INTERACTIONS** 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.PS2B.c)	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems.

ENERGY

Performance Expectation	Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
Clarification Statement	Emphasis is on descriptive relationships between kinetic energy and mass as well as kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different masses of rocks downhill, or the impact of a wiffle ball versus a tennis ball.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. **Analyzing and interpreting data:** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships. 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**DEFINITIONS OF ENERGY** 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.PS3A.a)	**SCALE, PROPORTION, AND QUANTITY** 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.

ENERGY

Performance Expectation	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.
Clarification Statement	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, or a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, or written descriptions of systems.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems **2. Developing and using models:** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop a model to describe unobservable mechanisms. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**DEFINITIONS OF ENERGY** An object or system of objects may also contain stored (potential) energy, depending on their relative positions. (MS.PS3A.b) **RELATIONSHIP BETWEEN ENERGY AND FORCES** 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.PS3C.a)	**SYSTEMS AND SYSTEM MODELS** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

Performance Expectation	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave and how the frequency and wavelength change the expression of the wave.
Clarification Statement	Emphasis is on describing mechanical waves with both qualitative and quantitative thinking.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions (for science) and defining problems (for engineering) 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data **5. Using mathematics and computational thinking:** Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. • Use mathematical representations to describe and/or support scientific conclusions and design solutions. 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**WAVE PROPERTIES** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS.PS4A.a)	**PATTERNS** Graphs, charts, and images can be used to identify patterns in data.

WAVES AND THEIR APPLICATIONS IN TECHNOLOGIES FOR INFORMATION TRANSFER

Performance Expectation	Develop and use a model to describe that waves are refracted, reflected, absorbed, transmitted, or scattered through various materials.
Clarification Statement	Emphasis is on both light and mechanical waves interacting with various objects such as light striking a mirror or a water wave striking a jetty. Examples of models could include drawings, simulations, or written descriptions.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions (for science) and defining problems (for engineering) **2. Developing and using models:** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**WAVE PROPERTIES** A sound wave needs a medium through which it is transmitted. (MS.PS4A.b) **ELECTROMAGNETIC RADIATION** When light shines on an object, it is reflected, absorbed, transmitted, or scattered through the object, depending on the object's material and the frequency (color) of the light. (MS.PS4B.a) 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 (Refraction). (MS.PS4B.b) A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through a vacuum, it cannot be a mechanical wave, like sound or water waves. (MS.PS4B.c)	**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.

EARTH'S PLACE IN THE UNIVERSE

Performance Expectation	Develop and use a model of the Earth-sun-moon system to describe the reoccurring patterns of lunar phases, eclipses of the sun and moon, and seasons.
Clarification Statement	Earth's rotation relative to the positions of the moon and sun describes the occurrence of tides; the revolution of Earth around the sun explains the annual cycle of the apparent movement of the constellations in the night sky; the moon's revolution around Earth explains the cycle of spring/neap tides and the occurrence of eclipses; the moon's elliptical orbit mostly explains the occurrence of total and annular eclipses. Examples of models can be physical, graphical, or conceptual.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems **2. Developing and using models:** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and use a model to describe phenomena 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**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.ESS1A.a) **EARTH AND THE SOLAR SYSTEM** 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.ESS1B.b)	**PATTERNS** Patterns can be used to identify cause and effect relationships.

EARTH'S PLACE IN THE UNIVERSE

Performance Expectation	Use a model to describe the role of gravity in the motions within galaxies and the solar system.
Clarification Statement	Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as their school or state).

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems **2. Developing and using models:** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**THE UNIVERSE AND ITS STARS** Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS.ESS1A.b) **EARTH AND THE SOLAR SYSTEM** The solar system consists of the sun and a collection of objects, including planets, their natural satellite(s) (moons), and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS.ESS1B.a) The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS.ESS1B.c)	**SYSTEMS AND MODELS** Models (e.g., physical, mathematical, computer models) can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems.

EARTH'S PLACE IN THE UNIVERSE

Performance Expectation	Analyze and interpret data to determine scale properties of objects in the solar system.
Clarification Statement	Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), atmospheric composition, surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data:** Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to determine similarities and differences in findings. 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**EARTH AND THE SOLAR SYSTEM** The solar system consists of the sun and a collection of objects, including planets, their natural satellite(s) (moons), comets, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS.ESS1B.a)	**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.

EARTH AND HUMAN ACTIVITY

Performance Expectation	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.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. **Engaging in argument from evidence**: Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • 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. 8. Obtaining, evaluating, and communicating information	**HUMAN IMPACTS ON EARTH SYSTEMS** 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. (MS.ESS3C.b) **BIOGEOLOGY** Living organisms interact with Earth materials resulting in changes of the Earth. (MS.ESS2E.a) **RESOURCE MANAGEMENT FOR LOUISIANA** Responsible management of Louisiana's natural resources promotes economic growth, a healthy environment, and vibrant productive ecosystems. (MS.EVS1B.a)	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems.

FROM MOLECULES TO ORGANISMS: STRUCTURES AND PROCESSES

Performance Expectation	Conduct an investigation to provide evidence that living things are made of cells, either one or many different numbers and types.
Clarification Statement	Emphasis is on developing evidence that living things are made of cells, distinguishing between living and nonliving things, and understanding that living things may be made of one or many cells, including specialized cells. Examples could include animal cells (blood, muscle, skin, nerve, bone, or reproductive) or plant cells (root, leaf, or reproductive).

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. **Planning and carrying out investigations:** Planning and carrying out investigations to answer questions (science) or test solutions (engineering) to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. • 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. 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**STRUCTURE AND FUNCTION** All living things are made up of cells, which are the smallest living unit. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS.LS1A.a)	**SCALE, PROPORTION, AND QUANTITY** Phenomena that can be observed at one scale may not be observable at another scale.

FROM MOLECULES TO ORGANISMS: STRUCTURES AND PROCESSES

Performance Expectation	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
Clarification Statement	Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, such as the nucleus, chloroplasts, mitochondria, cell membrane, or cell wall.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems **2. Developing and using models:** Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**STRUCTURE AND FUNCTION** Within cells, special structures (organelles) are responsible for particular functions. The cell membrane forms the boundary that controls the material(s) that enter and leave the cells in order to maintain homeostasis. (MS.LS1A.b)	**STRUCTURE AND FUNCTION** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function.

Grade 6

DBR-6-MS-LS2-1

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Expectation	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
Clarification Statement	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 or scarce resources.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations **4. Analyzing and interpreting data:** Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. • Analyze and interpret data to provide evidence for phenomena. 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS.LS2A.a) 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.LS2A.b) Growth of organisms and population increases are limited by access to resources. (MS.LS2A.c)	**CAUSE AND EFFECT** Cause and effect relationships may be used to predict phenomena in natural or designed systems.

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Expectation	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
Clarification Statement	Emphasis is on (1) predicting consistent patterns of interactions in different ecosystems and (2) relationships among and between biotic and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, mutually beneficial, or other symbiotic relationships.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking **6. Constructing explanations and designing solutions:** Constructing explanations (science) and designing solutions (engineering) in 6–8 builds on K– 5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. • Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) and/or describe(s) phenomena. 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS** 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.LS2A.d)	**PATTERNS** Patterns can be used to identify cause and effect relationships.

ECOSYSTEMS: INTERACTIONS, ENERGY, AND DYNAMICS

Performance Expectation	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
Clarification Statement	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.

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Asking questions and defining problems **2. Developing and using models:** Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. • Develop and/or use a model to predict and/or describe phenomena. 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information	**CYCLE OF MATTER AND ENERGY TRANSFER IN ECOSYSTEMS** 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. (MS.LS2B.a) Transfers of matter into and out of the physical environment occur at every level. (MS.LS2B.b) Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. (MS.LS2B.c) The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. Geochemical cycles include carbon, nitrogen, and the water cycle. (MS.LS2B.d)	**ENERGY AND MATTER** The transfer of energy can be tracked as energy flows through a designed or natural system.