Mississippi College- and Career-Readiness Standards for Science Correlation to *PhD Science*™

Green indicates that *PhD Science*™ fully addresses the standard within the grade level.

Blue indicates that *PhD Science* covers the standard but in a different grade level.

Yellow indicates that *PhD Science* partially covers the standard within the grade level.

Red indicates that *PhD Science* does not cover the standard.

Key: Module (M), Lesson (L)

PhD Science Level 3

The Grade 3 Mississippi College- and Career-Readiness Standards are almost entirely covered by the Level 3 *PhD Science* curriculum but some out of grade level. Also, Standards L.3.2, L.3.4, P.3.5, E.3.7A, E.3.7B, and E.3.10 are partially covered but not in the detail specified. A detailed analysis of alignment appears in the table below.

Grade 3 Disciplinary Core Ideas, Standards, and Performance Objectives			**Aligned *PhD Science* Lessons**
Life Science			
Disciplinary Core Idea: L.3.1 Hierarchical Organization			
	Plants and animals have physical characteristics and features that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce in an environment.		Level 3 M2 L16–L28
Standard L.3.1 Students will demonstrate an understanding of internal and external structures in plants and animals and how they relate to their growth, survival, behavior, and reproduction within an environment.			
L.3.1.1	Examine evidence to communicate information that the internal and external structures of animals function to support survival, growth, and behavior.		Level 4 M3 L1–L6 Level 4 M3 L12–L28
L.3.1.2	Examine evidence to communicate information that the internal and external structures of plant function to support survival, growth, behavior, and reproduction.		Level 4 M3 L26–L28
L.3.1.3	Obtain and communicate examples of physical features or behaviors of vertebrates and invertebrates and how these characteristics help them survive in particular environments.		Level 3 M2 L1–L2 Level 3 M2 L9–L19 Level 3 M2 L22–L28
Disciplinary Core Idea: L.3.2 Reproduction and Heredity			
	Scientists have identified and classified many types of plants and animals. Some characteristics and traits that organisms have are inherited, and some result from interactions with the environment.		Level 3 M3 L1–L18 Level 3 M3 L26–L28
Standard L.3.2 Students will demonstrate an understanding that through reproduction, the survival and physical features of plants and animals are inherited traits from parent organisms but can also be influenced by the environment.			
L.3.2.1	Identify traits and describe how traits are passed from parent organism(s) to offspring in plants and animals.		Level 3 M3 L14–L18 Level 3 M3 L26–L28

L.3.2.2	Describe and provide examples of plant and animal offspring from a single parent organism as being an exact replica with identical traits as the parent organism.		
L.3.2.3	Describe and provide examples of offspring from two parent organisms as containing a combination of inherited traits from both parent organisms.		Level 3 M3 L14–L18 Level 3 M3 L26–L28
L.3.2.4	Obtain and communicate data to provide evidence that plants and animals have traits inherited from both parent organisms and that variations of these traits exist in groups of similar organisms.		Level 3 M3 L1–L6 Level 3 M3 L16–L18 Level 3 M3 L26–L28
L.3.2.5	Research to justify the concept that traits can be influenced by the environment.		Level 3 M3 L9–L13 Level 3 M3 L19–L20 Level 3 M3 L26–L28
Disciplinary Core Idea: L.3.4 Adaptations and Diversity			
	When the environment or habitat changes, some plants and animals survive and reproduce, some move to new locations, and some die. Scientists can obtain historical information from fossils to provide evidence of both the organism and environments in which they lived.		Level 3 M2 L16–L28
Standard L.3.4 Students will demonstrate an understanding of how adaptations allow animals to satisfy life needs and respond both physically and behaviorally to their environment.			
L.3.4.1	Obtain data from informational text to explain how changes in habitats can be beneficial or harmful to the organisms that live there.		Level 3 M2 L16–L21
L.3.4.2	Ask questions to predict how natural or man-made changes in a habitat cause plants and animals to respond in different ways, including hibernating, migrating, responding to light, death, or extinction.		Level 3 M2 L16–L21
L.3.4.3	Analyze and interpret data to explain how variations in characteristics among organisms of the same species may provide advantages in surviving, finding mates, and reproducing.		Level 3 M3 L21–L28
L.3.4.4	Define and improve a solution to a problem created by environmental changes and any resulting impacts on the types of density and distribution of plant and animal populations living in the environment. Use an engineering design process to define the problem, design, construct, evaluate, and improve the environment.		Level 3 M2 L16–L28
L.3.4.5	Construct scientific argument using evidence from fossils of plants and animals that lived long ago to infer the characteristics of early environments.		Level 3 M2 L1–L8 Level 3 M2 L26–L28
Physical Science			
Disciplinary Core Idea: P.3.5 Organization of Matter and Chemical Interactions			
	Matter is made up of particles that are too small to be seen. Even though the particles are very small, the movement and spacing of these particles determine the basic properties of matter. Matter exists in several different states and is classified based on observable and measurable properties. Matter can be changed from one state to another when heat (i.e., thermal energy) is added or removed.		Level 5 M1 L1–L17 Level 5 M1 L23–L26
Standard P.3.5 Students will demonstrate an understanding of the physical properties of matter to explain why matter can change states between a solid, liquid, or gas dependent upon the addition or removal of heat.			
P.3.5.1	Plan and conduct scientific investigations to determine how changes in heat change matter from one state to another.		Level 5 M1 L9–L12

P.3.5.2	Develop and use models to communicate the concept that matter is made of particles too small to be seen that move freely around in space.		Level 5 M1 L5–L10 Level 5 M1 L23–L26
P.3.5.3	Plan and conduct investigations that particles speed up or slow down with addition or removal of heat.		
Disciplinary Core Idea: P.3.6 Motions, Forces, and Energy			
	Magnets are a specific type of solid that can attract and repel certain other kinds of materials, including other magnets. There are some materials that are neither attracted to nor repelled by magnets. Because of their special properties, magnets are used in various ways. Magnets can exert forces—a push or a pull—on other magnets or magnetic materials, causing energy transfer between them, even when the objects are not touching.		Level 3 M4 L19–L30
Standard P.3.6 Students will demonstrate an understanding of magnets and the effects of pushes, pulls, and friction on the motion of objects.			
P.3.6.1	Compare and contrast the effects of different strengths and directions of forces on the motion of an object.		Level 3 M4 L1–L18 Level 3 M4 L28–L30
P.3.6.2	Plan an experiment to investigate the relationship between a force applied to an object and resulting motion of the object.		Level 3 M4 L1–L18 Level 3 M4 L28–L30
P.3.6.3	Research and communicate information to explain how magnets are used in everyday life.		Level 3 M4 L19–L21
P.3.6.4	Define and solve a simple design problem by applying scientific ideas about magnets. Use an engineering design process to define the problem, design, construct, evaluate, and improve the magnet.		Level 3 M4 L22–L30
Earth and Space Science			
Disciplinary Core Idea: E.3.7A Earth's Structure and History			
	Since its formation, the Earth has undergone a great deal of geological change driven by its composition and systems. Scientists use many methods to learn more about the history and age of Earth. Earth materials include rocks, soils, water, and gases. Rock is composed of different combinations of minerals. Smaller rocks come from the breakage and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains, and contains many living organisms.		Level 5 M2 L6–L7 Level 5 M2 L10–L14 Level 5 M2 L24–L26 Level 5 M3 L1–L13 Level 5 M3 L24–L27
Standard E.3.7A Students will demonstrate an understanding of the various processes involved in the rock cycle, superposition of rock layers, and fossil formation.			
E.3.7A.1	Plan and conduct controlled scientific investigations to identify the processes involved in forming the three major types of rock, and investigate common techniques used to identify them.		
E.3.7A.2	Develop and use models to demonstrate the processes involved in the development of various rock formations, including superposition, and how those formations can fracture and move over time.		
E.3.7A.3	Ask questions to generate testable hypotheses regarding the formation and location of fossil types, including their presence in some sedimentary rock.		Level 4 M1 L4–L5 Level 4 M1 L25–L27
Disciplinary Core Idea: E.3.7B Earth's Structure and History			
	Earth has an active mantle, which interacts with the Earth's crust to drive plate tectonics and form new rocks. Resulting surface features change through interactions with water, air, and living things. Waves, wind, water, and ice shape and reshape the Earth's land surface by		Level 4 M1 L6–L11 Level 4 M1 L25–L27

	eroding rock and soil in some areas and depositing them in other areas. Scientists use many methods to learn more about the history and age of Earth.		
Standard E.3.7B Students will demonstrate an understanding of the composition of Earth and the processes which change Earth's landforms.			
E.3.7B.1	Obtain and evaluate scientific information to describe the four major layers of Earth and the varying compositions of each layer.		
E.3.7B.2	Develop and use models to describe the characteristics of Earth's continental landforms and classify landforms as volcanoes, mountains, valleys, canyons, planes, and islands.		Level 4 M1 L18–L20 Level 4 M1 L25–L27
E.3.7B.3	Develop and use models of weathering, erosion, and deposition processes which explain the appearance of various Earth features.		Level 4 M1 L1–L11 Level 4 M1 L18 Level 4 M1 L25–L27
E.3.7B.4	Compare and contrast constructive and destructive processes of the Earth.		
Earth and Space Science			
Disciplinary Core Idea: E.3.9 Earth's Systems and Cycles			
	The Earth's land can be situated above or submerged below water. Water in the atmosphere changes states according to energy levels driven by the sun and its interactions with various Earth components, both living and non-living. The downhill movement of water as it flows to the ocean shapes the appearance of the land.		Level 4 M1 L18–L20 Level 4 M1 L25–L27 Level 5 M3 L4–L5 Level 5 M3 L24–L27
Standard E.3.9 Students will demonstrate an understanding of how the Earth's systems (i.e., geosphere, hydrosphere, atmosphere, and biosphere) interact in multiple ways to affect Earth's surface materials and processes.			
E.3.9.1	Develop models to communicate the characteristics of the Earth's major systems, including the geosphere, hydrosphere, atmosphere, and biosphere.		Level 5 M3 L1–L3 Level 5 M3 L6–L11
E.3.9.2	Construct explanations of how different landforms and surface features result from the location and movement of water on Earth's surface.		Level 4 M1 L8–L11 Level 4 M1 L18 Level 4 M1 L21–L22 Level 4 M1 L25–L27
E.3.9.3	Use graphical representations to communicate the distribution of freshwater and saltwater on Earth.		Level 5 M3 L4–L5 Level 5 M3 L19–L26
Disciplinary Core Idea: E.3.10 Earth's Resources			
	Earth is made of materials that provide resources for human activities, and their use affects the environment in multiple ways. Some resources are renewable and others are not.		Level 4 M1 L21–L27 Level 5 M3 L14–L18 Level 5 M3 L24–L27
Standard E.3.10 Students will demonstrate an understanding that all materials, energy, and fuels that humans use are derived from natural sources.			
E.3.10.1	Identify some of Earth's resources that are used in everyday life such as water, wind, soil, forests, oil, natural gas, and minerals and classify as renewable or nonrenewable.		Level 4 M1 L23–L24
E.3.10.2	Obtain and communicate information to exemplify how humans attain, use, and protect renewable and nonrenewable Earth resources.		Level 5 M3 L14–L16
E.3.10.3	Use maps and historical information to identify natural resources in the state connecting (a) how resources are used for human needs and (b) how the use of those resources impacts the environment.		

E.3.10.4	Design a process for cleaning a polluted environment. Use an engineering design process to define the problem, design, construct, evaluate, and improve the environment.		

Science and Engineering Practices			**Aligned *PhD Science* Lessons**
1	Ask Questions and Define Problems • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.		Level 3 M1 L1–L3 Level 3 M1 L21–L26 Level 3 M2 L1–L2 Level 3 M3 L1–L3 Level 3 M3 L12–L13 Level 3 M4 L1–L3 Level 3 M4 L7–L9 Level 3 M4 L15–L16 Level 3 M4 L19–L30
2	Develop and Use Models • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.		Level 3 M1 L1–L3 Level 3 M1 L19–L20 Level 3 M2 L1–L3 Level 3 M2 L6–L12 Level 3 M2 L22–L25 Level 3 M3 L7–L11 Level 3 M3 L21–L25 Level 3 M4 L1–L3 Level 3 M4 L17–L18 Level 3 M4 L23–L27
3	Plan and Carry Out Investigations • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.		Level 3 M2 L4–L5 Level 3 M3 L12–L13 Level 3 M4 L7–L18 Level 3 M4 L23–L30
4	Analyze and Interpret Data • Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.		Level 3 M1 L4–L15 Level 3 M1 L19–L20 Level 3 M1 L27–L29 Level 3 M2 L3–L8 Level 3 M2 L16–L19 Level 3 M3 L4–L8 Level 3 M3 L14–L20 Level 3 M4 L4–L9
5	Use Mathematics and Computational Thinking		Level 3 M1 L4–L12

	• Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems. • Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.		Level 3 M2 L3 Level 3 M2 L16–L19 Level 3 M3 L7–L8 Level 3 M4 L23–L27
6	Construct Explanations and Design Solutions • Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.		Level 3 M1 L13–L15 Level 3 M1 L18 Level 3 M1 L21–L29 Level 3 M2 L6–L8 Level 3 M2 L22–L28 Level 3 M3 L9–L11 Level 3 M3 L14–L15 Level 3 M3 L21–L28 Level 3 M4 L10–L14 Level 3 M4 L19–L21 Level 3 M4 L28–L30
7	Engage in Argument from Evidence • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.		Level 3 M1 L21–L26 Level 3 M2 L9–L15 Level 3 M2 L20–L21 Level 3 M3 L16–L20 Level 3 M4 L10–L14
8	Obtain, Evaluate, and Communicate Information • Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices. • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.		Level 3 M1 L16–L17 Level 3 M2 L13–L15 Level 3 M2 L20–L21 Level 3 M4 L22

Crosscutting Concepts	**Aligned *PhD Science* Lessons**

1	Patterns • Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products. • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation.		Level 3 M1 L11–L15 Level 3 M1 L19–L20 Level 3 M1 L27–L29 Level 3 M2 L3–L8 Level 3 M2 L13–L15 Level 3 M3 L1–L8 Level 3 M3 L14–L18 Level 3 M3 L26–L28 Level 3 M4 L1–L9 Level 3 M4 L28–L30
2	Cause and Effect • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship.		Level 3 M1 L1–L3 Level 3 M1 L16–L18 Level 3 M1 L21–L29 Level 3 M2 L9–L12 Level 3 M2 L16–L28 Level 3 M3 L9–L13 Level 3 M3 L19–L25 Level 3 M4 L1–L3 Level 3 M4 L10–L30
3	Scale, Proportion, and Quantity • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.		Level 3 M1 L4–L10 Level 3 M2 L1–L2 Level 3 M3 L1–L3 Level 3 M3 L14–L15
4	Systems and System Models • A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. • A system can be described in terms of its components and their interactions.		Level 3 M1 L1–L3 Level 3 M1 L16–L20 Level 3 M2 L6–L15 Level 3 M2 L20–L28 Level 3 M3 L9–L11 Level 3 M4 L1–L30
5	Energy and Matter • Matter is made of particles. • Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. • Energy can be transferred in various ways and between objects.		Level 5 M1 L5–L8 Level 5 M1 L13–L14 Level 5 M1 L23–L26 Level 5 M2 L6–L11 Level 5 M2 L14–L19 Level 5 M2 L24–L26 Level 5 M3 L10–L11 Level 5 M4 L3–L4
6	Structure and Function • Different materials have different substructures, which can sometimes be observed. • Substructures have shapes and parts that serve functions.		Level 3 M1 L21–L26 Level 3 M2 L1–L3 Level 3 M2 L9–L12 Level 3 M3 L4–L6 Level 3 M3 L21–L28
7	Stability and Change • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change.		Level 3 M1 L4–L15 Level 3 M1 L27–L29 Level 3 M2 L16–L19 Level 3 M3 L7–L8 Level 3 M3 L12–L13 Level 3 M3 L19–L20 Level 3 M3 L26–L28

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Key: Module (M), Lesson (L)

PhD Science Level 4

The Grade 4 Mississippi College- and Career-Readiness Standards are almost entirely covered by the Level 4 *PhD Science* curriculum but some out of grade level, and Standards L.4.1, P.4.6A, and P.4.6B are partially covered but not in the detail specified. Standard P.4.6C is not covered. A detailed analysis of alignment appears in the table below.

Grade 4 Disciplinary Core Ideas, Standards, and Performance Objectives		**Aligned *PhD Science* Lessons**
Life Science		
Disciplinary Core Idea: L.4.1 Hierarchical Organization		
	All organisms need energy for growth and development. Animals have specialized structures and systems for obtaining and processing energy. These structures and systems cannot function properly without adequate nourishment. Living organisms can be adversely affected by environmental conditions or disease.	Level 5 M2 L8–L9 Level 5 M2 L15–L19 Level 5 M2 L24–L26
Standard L.4.1 Students will demonstrate an understanding of the organization, functions, and interconnections of the major human body systems.		
L.4.1.1	Use technology or other resources to research and discover general system function (e.g., machines, water cycle) as they relate to human organ systems and identify organs that work together to create organ systems.	Level 4 M3 L1–L5
L.4.1.2	Obtain and communicate data to describe patterns that indicate the nature of relationships between human organ systems, which interact with one another to control digestion, respiration, circulation, excretion, movement, coordination, and protection from infection.	
L.4.1.3	Construct models of organ systems to demonstrate both the unique function of the system and how multiple organs and organ systems work together to accomplish more complex functions.	
L.4.1.4	Research and communicate how noninfectious diseases and infectious diseases serve to disrupt the function of the body system.	
L.4.1.5	Using informational text, investigate how scientific fields, medical specialties, and research methods help us find new ways to maintain a healthy body and lifestyle.	

Disciplinary Core Idea: L.4.2 Reproduction and Heredity			
	Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. All of Earth's cycles are driven by energy which can be traced back to the sun.		Level 5 M2 L8–L9 Level 5 M2 L15–L19 Level 5 M2 L24–L26
Standard L.4.2 Students will demonstrate an understanding of life cycles, including familiar plants and animals.			
L.4.2.1	Compare and contrast life cycles of familiar plants and animals.		Level 3 M3 L7–L8 Level 3 M3 L23–L28
L.4.2.2	Develop and use models to explain the unique and diverse life cycles of organisms other than humans including commonalities.		Level 3 M3 L7–L8 Level 3 M3 L23–L28
Physical Science			
Disciplinary Core Idea: P.4.6A Motions, Forces, and Energy			
	As different forms of energy, heat and electricity can be produced in different ways and are transferred and conducted from one form or object to another. Some materials can be conductors or insulators of heat energy. Electricity can be transferred from place to place by electric currents to produce motion, sound, heat, or light.		Level 4 M2 L1–L26
Standard P.4.6A Students will demonstrate an understanding of the common sources and uses of heat and electric energy and the materials used to transfer heat and electricity.			
P.4.6A.1	Obtain and communicate information to compare how different processes serve as sources of heat energy.		Level 4 M2 L4–L5
P.4.6A.2	Plan and conduct scientific investigations to classify different materials as either an insulator or conductor of electricity.		
P.4.6A.3	Develop models demonstrating how heat and electrical energy can be transformed into other forms of energy.		Level 4 M2 L10–L11
P.4.6A.4	Develop models that demonstrate the path of an electric current in a complete, simple circuit.		
P.4.6A.5	Use informational text and technology resources to communicate technological breakthroughs made by historical figures in electricity.		
P.4.6A.6	Design a device that converts any form of energy from one form to another. Use an engineering design process to define the problem, design, construct, evaluate, and improve the device.		Level 4 M2 L12–L23
Disciplinary Core Idea: P.4.6B Motions, Forces, and Energy			
	Light, as a form of energy, has specific properties, including brightness. Light travels in a straight line until it strikes an object. The way light behaves when it strikes an object depends on the object's properties.		Level 4 M4 L1–L13 Level 4 M4 L20–L26
Standard P.4.6B Students will demonstrate an understanding of the properties of light as forms of energy.			
P.4.6B.1	Construct scientific evidence to support the claim that white light is made up of different colors. Include the work of Sir Isaac Newton to communicate results.		
P.4.6B.2	Obtain and communicate information to explain how the visibility of an object is related to light.		Level 4 M4 L1–L17 Level 4 M4 L25–L27
P.4.6B.3	Develop and use models to communicate how light travels and behaves when it strikes an object, including reflection, refraction, and absorption.		Level 4 M4 L7–L17 Level 4 M4 L25–L27
P.4.6B.4	Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.		Level 4 M4 L7–L17 Level 4 M4 L25–L27
Disciplinary Core Idea: P.4.6C Motions, Forces, and Energy			

	Sound, as a form of energy, is produced by vibrating objects (matter) and has specific properties, including pitch and volume. Sound travels through air and other materials and is used to communicate information in various forms of technology.		Level 4 M2 L10 Level 4 M4 L3–L8 Level 4 M4 L26
Standard P.4.6C Students will demonstrate an understanding of the properties of sound as a form of energy.			
P.4.6C.1	Plan and conduct scientific investigations to test how different variables affect the properties of sound.		
P.4.6C.2	In relation to how sound is perceived by humans, analyze and interpret data from observations and measurements to report how changes in vibration affect the pitch and volume of sound.		
P.4.6C.3	Obtain and communicate information about scientists who pioneered in the science of sound.		
Earth and Space Science			
Disciplinary Core Idea: E.4.9A Earth's Systems and Cycles			
	Earth's atmosphere is a mixture of gases, including water vapor and oxygen. Water, which is found almost everywhere on Earth, including the atmosphere, changes form and cycles between Earth's surface to the air and back again. This cycling of water is driven by energy from the sun. The movement of water in the water cycle is a major process that influences weather conditions. Clouds form during this cycle and various types of precipitation result.		Level 5 M3 L4–L5 Level 5 M3 L8 Level 5 M3 L24–L27
Standard E.4.9A Students will demonstrate an understanding of how the water cycle is propelled by the sun's energy.			
E.4.9A.1	Develop and use models to explain how the sun's energy drives the water cycle.		Level 5 M3 L6–L8
Disciplinary Core Idea: E.4.9B Earth's Systems and Cycles			
	Scientists record patterns in weather conditions over time and across the globe to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time.		Level 3 M1 L1–L15 Level 3 M1 L19–L20 Level 3 M1 L27–L29
Standard E.4.9B Students will demonstrate an understanding of weather and climate patterns.			
E.4.9B.1	Analyze and interpret data to predict changes in weather over time.		Level 3 M1 L1–L15 Level 3 M1 L19–L20 Level 3 M1 L27–L29
E.4.9B.2	Construct explanations about regional climate differences using maps and long-term data from various regions.		Level 3 M1 L11–L15 Level 3 M1 L27–L29
E.4.9B.3	Design weather instruments utilized to measure weather conditions. Use an engineering design process to define the problem, design, construct, evaluate, and improve the weather instrument.		Level 3 M1 L4–L7
Disciplinary Core Idea: E.4.9C Earth's Systems and Cycles			
	Earth's oceans and landforms can be affected in various ways by natural processes in one or more of Earth's spheres (i.e., atmosphere, biosphere, geosphere, and hydrosphere). Humans cannot eliminate natural hazards caused by these processes but can take steps to reduce their impacts. Human activities can affect the land and oceans in positive and negative ways.		Level 3 M1 L1–L3 Level 3 M1 L16–L29 Level 5 M3 L1–L13 Level 5 M3 L24–L27
Standard E.4.9C Students will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.			

E.4.9C.1	Analyze and interpret data to describe and predict how natural processes affect Earth's surface.		Level 4 M1 L6–L11 Level 4 M1 L18
E.4.9C.2	Develop and use models of natural processes to explain the effect of the movement of water on the ocean shore zone, including beaches, barrier islands, estuaries, and inlets.		Level 5 M3 L12–L13
E.4.9C.3	Construct scientific arguments from evidence to support claims that human activities, such as conservation efforts or pollution, affect the land, oceans, and atmosphere of Earth.		Level 4 M1 L21–L24
E.4.9C.4	Research and explain how systems interact and support life in the biosphere.		Level 5 M3 L1–L3 Level 5 M3 L6–13 Level 5 M3 L19–L26
E.4.9C.5	Obtain and communicate information about severe weather phenomena to explain steps humans can take to reduce the impact of severe weather events.		Level 3 M1 L1–L3 Level 3 M1 L16–L29
Disciplinary Core Idea: E.4.10 Earth's Resources			
	Energy and fuels are derived from natural sources and human use of these materials affects the environment in multiple ways. Due to limited natural resources, humans are exploring the use of abundant solar, water, wind, and geothermal energy resources to develop innovative, high-tech renewable energy systems.		Level 4 M1 L21–L27
Standard E.4.10 Students will demonstrate an understanding of the various sources of energy used for human needs along with their effectiveness and possible impacts.			
E.4.10.1	Organize simple data sets to compare energy and pollution output of various traditional, nonrenewable resources.		Level 4 M1 L23–L24
E.4.10.2	Use technology or informational text to investigate, evaluate, and communicate various forms of clean energy generation.		Level 4 M2 L1–L3

Science and Engineering Practices			**Aligned *PhD Science* Lessons**
1	Ask Questions and Define Problems • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.		Level 4 M1 L1–L2 Level 4 M2 L1–L3 Level 4 M2 L8–L9 Level 4 M3 L1–L3 Level 4 M3 L15–L19 Level 4 M4 L1–L2
2	Develop and Use Models • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.		Level 4 M1 L1–L2 Level 4 M2 L1–L3 Level 4 M2 L8–L11 Level 4 M2 L15–L16 Level 4 M3 L1–L3 Level 4 M3 L7–L11 Level 4 M4 L1–L8 Level 4 M4 L10–L23

	• Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.		
3	Plan and Carry Out Investigations • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.		Level 4 M1 L6–L11 Level 4 M1 L21–L22 Level 4 M2 L6–L7 Level 4 M2 L10–L14 Level 4 M3 L15–L19 Level 4 M4 L7–L9 Level 4 M4 L14–L16 Level 4 M4 L20–L23
4	Analyze and Interpret Data • Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.		Level 4 M1 L12–L20 Level 4 M1 L23–L24 Level 4 M4 L10–L13
5	Use Mathematics and Computational Thinking • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems. • Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.		Level 4 M2 L8–L9
6	Construct Explanations and Design Solutions • Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard). • Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.		Level 4 M1 L3–L7 Level 4 M1 L12–L18 Level 4 M1 L21–L22 Level 4 M1 L25–L27 Level 4 M2 L4–L5 Level 4 M2 L15–L26 Level 4 M3 L24–L25 Level 4 M3 L29–L31 Level 4 M4 L14–L26
7	Engage in Argument from Evidence • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model.		Level 4 M3 L4–L5 Level 4 M3 L21–L23 Level 4 M3 L26–L28 Level 4 M4 L7–L8

	• Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.		
8	Obtain, Evaluate, and Communicate Information • Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Compare and/or combine across complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices. • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.		Level 4 M1 L3–L5 Level 4 M1 L23–L24 Level 4 M3 L4–L6 Level 4 M3 L10–L11 Level 4 M3 L20–L23 Level 4 M3 L26–L28 Level 4 M4 L17–L19

Crosscutting Concepts			**Aligned *PhD Science* Lessons**
1	Patterns • Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products. • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation.		Level 4 M1 L1–L5 Level 4 M1 L18–L22 Level 4 M2 L4–L5 Level 4 M2 L8–L11 Level 4 M2 L24–L26 Level 4 M3 L1–L3 Level 4 M3 L7–L11 Level 4 M3 L20 Level 4 M3 L24–L28 Level 4 M4 L1–L4 Level 4 M4 L7–L8 Level 4 M4 L17–L23
2	Cause and Effect • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship.		Level 4 M1 L6–L17 Level 4 M1 L19–L20 Level 4 M1 L23–L27 Level 4 M2 L1–L7 Level 4 M2 L10–L14 Level 4 M2 L24–L26 Level 4 M3 L6–L11 Level 4 M3 L15–L23 Level 4 M4 L3–L16 Level 4 M4 L24–L26
3	Scale, Proportion, and Quantity • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.		Level 4 M1 L3–L5
4	Systems and System Models		Level 4 M1 L1–L2

	• A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. • A system can be described in terms of its components and their interactions.		Level 4 M1 L12–L17 Level 4 M1 L21–L24 Level 4 M2 L1–L11 Level 4 M2 L15–L26 Level 4 M3 L4–L5 Level 4 M3 L7–L9 Level 4 M3 L15–L19 Level 4 M3 L21–L23 Level 4 M3 L26–L31 Level 4 M4 L1–L8 Level 4 M4 L10–L23
5	Energy and Matter • Matter is made of particles. • Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. • Energy can be transferred in various ways and between objects.		Level 4 M2 L1–L3 Level 4 M2 L8–L26 Level 4 M3 L1–L3 Level 4 M3 L10–L19
6	Structure and Function • Different materials have different substructures, which can sometimes be observed. • Substructures have shapes and parts that serve functions.		Level 4 M3 L4–L6 Level 4 M3 L20 Level 4 M3 L24–L25 Level 4 M3 L29–L31 Level 4 M4 L9 Level 4 M4 L24–L26
7	Stability and Change • Change is measured in terms of differences over time and may occur at different rates. • Some systems appear stable, but over long periods of time will eventually change.		Level 4 M1 L3–L11 Level 4 M1 L18–L20 Level 4 M1 L25–L27

Mississippi College- and Career-Readiness Standards for Science Correlation to *PhD Science*™

Green indicates that *PhD Science*™ fully addresses the standard within the grade level.

Blue indicates that *PhD Science* covers the standard but in a different grade level.

Yellow indicates that *PhD Science* partially covers the standard within the grade level.

Red indicates that *PhD Science* does not cover the standard.

Key: Module (M), Lesson (L)

PhD Science Level 5

The Grade 5 Mississippi College- and Career-Readiness Standards are almost entirely covered by the Level 3 *PhD Science* curriculum but some out of grade level. Also, Standards L.5.3A, L.5.3B, P.5.5A, P.5.5B, P.5.6, E.5.8A, and E.5.8B are partially covered but not in the detail specified. A detailed analysis of alignment appears in the table below.

Grade 5 Disciplinary Core Ideas, Standards, and Performance Objectives		**Aligned *PhD Science* Lessons**
Life Science		
Disciplinary Core Idea: L.5.3A Ecology and Interdependence		
	All organisms need energy to live and grow. Energy is obtained from the sun. Cells transform the energy that organisms need to perform essential life functions through a complex sequence of reactions in which chemical energy is transferred from one system of interacting molecules to another.	Level 5 M2 L6–L7 Level 5 M2 L15–L19 Level 5 M2 L24–L26
Standard L.5.3A Students will demonstrate an understanding of photosynthesis and the transfer of energy from the sun into chemical energy necessary for plant growth and survival.		
L.5.3A.1	Research and communicate the basic process of photosynthesis that is used by plants to convert light energy into chemical energy that can be stored and released to fuel an organism's activities.	Level 5 M2 L6–L7 Level 5 M2 L24–L26
L.5.3A.2	Analyze environments that do not receive direct sunlight and devise explanations as to how photosynthesis occurs, either naturally or artificially.	
Disciplinary Core Idea: L.5.3B Ecology and Interdependence		
	A major role an organism serves in an ecosystem can be described by the way in which it obtains its energy. Energy is transferred within an ecosystem by producers, consumers, or decomposers. A healthy ecosystem is one in which a diverse population of life forms can meet their needs in a relatively stable web of life.	Level 5 M2 L15–L19 Level 5 M2 L24–L26
Standard L.5.3B Students will demonstrate an understanding of a healthy ecosystem with a stable web of life and the roles of living things within a food chain and/or food web, including producers, primary and secondary consumers, and decomposers.		
L.5.3B.1	Obtain and evaluate scientific information regarding the characteristics of different ecosystems and the organisms they support.	Level 5 M2 L1–L2

L.5.3B.2	Develop and use a food chain model to classify organisms as producers, consumers, or decomposers. Trace the energy flow to explain how each group of organisms obtains energy.		Level 5 M2 L1–L2 Level 5 M2 L8–L20 Level 5 M2 L24–L26
L.5.3B.3	Design and interpret models of food webs to justify what effects the removal or the addition of a species would have on a specific population and/or the ecosystem as a whole.		Level 5 M2 L20–L26
L.5.3B.4	Communicate scientific or technical information that explains human positions in food webs and our potential impacts on these systems.		Level 5 M2 L8–L9
Physical Science			
Disciplinary Core Idea: P.5.5A Organization of Matter and Chemical Interactions			
	Matter can be segregated into tiny particles that are too small to see but can be detected by other methods. These tiny particles are referred to as atoms, which can be combined to form molecules. Substances exhibit specific properties that can be observed and measured.		Level 5 M1 L5–L10 Level 5 M1 L23–L26
Standard P.5.5A Students will demonstrate an understanding of the physical properties of matter.			
P.5.5A.1	Obtain and evaluate scientific information to describe basic physical properties of atoms and molecules.		
P.5.5A.2	Collect, analyze, and interpret data from measurements of the physical properties of solids, liquids, and gases.		Level 5 M1 L9–L17 Level 5 M1 L23–L26
P.5.5A.3	Analyze matter through observations and measurements to classify materials based on their properties.		Level 5 M1 L1–L4 Level 5 M1 L11–L17 Level 5 M1 L23–L26
P.5.5A.4	Make and test predictions about how the density of an object affects whether the object sinks or floats when placed in a liquid.		
P.5.5A.5	Design a vessel that can safely transport a dense substance through water at various distances and under variable conditions. Use an engineering design process to define the problem, design, construct, evaluate, and improve the vessel.		
Disciplinary Core Idea: P.5.5B Organization of Matter and Chemical Interactions			
	Substances of the same type can be classified by their similar, observable properties. Substances can be combined in a variety of ways. A mixture is formed when two or more kinds of matter are physically combined. Solutions are a special type of mixture in which one substance is distributed evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different physical ways.		Level 5 M1 L1–L2 Level 5 M1 L15–L26
Standard P.5.5B Students will demonstrate an understanding of mixtures and solutions.			
P.5.5B.1	Obtain and evaluate scientific information to describe what happens to the properties of substances in mixtures and solutions.		Level 5 M1 L1–L2 Level 5 M1 L13–L26
P.5.5B.2	Analyze and interpret data to communicate that the concentration of a solution is determined by the relative amount of solute versus solvent in various mixtures.		
P.5.5B.3	Investigate how different variables affect the rate at which a solute will dissolve.		
P.5.5B.4	Design an effective system for separating various mixtures. Use an engineering design process to define the problem, design, construct, evaluate, and improve the system.		Level 5 M1 L13–L14
Disciplinary Core Idea: P.5.5C Organization of Matter and Chemical Interactions			
	Physical properties can be observed and measured without changing the composition of matter. A physical change occurs when the matter's		Level 5 M1 L9–L17 Level 5 M1 L23–L26

	physical appearance is altered while leaving the composition of the matter unchanged. When two or more substances are mixed together, a new substance with different properties can sometimes be formed, but the total amount (i.e., mass) of the substances is conserved (i.e., total mass stays the same). In a chemical change, the composition of the original matter is altered to create a new substance. A different compound is present at the completion of the chemical change.		
Standard P.5.5C Students will demonstrate an understanding of the difference between physical and chemical changes.			
P.5.5C.1	Analyze and communicate the results of chemical changes that result in the formation of new materials.		Level 5 M1 L11–L26
P.5.5C.2	Analyze and communicate the results of physical changes to a substance that results in a reversible change.		Level 5 M1 L11–L26
P.5.5C.3	Analyze and interpret data to support claims that when two substances are mixed, the total weight of matter is conserved.		Level 5 M1 L9–L17 Level 5 M1 L23–L26
Disciplinary Core Idea: P.5.6 Motions, Forces, and Energy			
	Gravity is a force that draws objects to Earth. This force acting on an object near Earth's surface pulls that object toward the planet's center. The motion of an object can be described in terms of its position, direction, and speed. Multiple factors determine the rate and motion of an object. Other than Earth, any celestial objects will exert varying gravitational pulls on other objects according to their mass and density.		Level 5 M4 L3–L4 Level 5 M4 L24–L26
Standard P.5.6 Students will demonstrate an understanding of the factors that affect the motion of an object through a study of Newton's Laws of Motion.			
P.5.6.1	Obtain and communicate information describing gravity's effect on an object.		Level 5 M4 L3–L4 Level 5 M4 L24–L26
P.5.6.2	Predict the future motion of various objects based on past observation and measurement of position, direction, and speed.		Level 3 M4 L1–L9 Level 3 M4 L28–L30
P.5.6.3	Develop and use models to explain how the amount or type of force, both contact and noncontact, affects the motion of an object.		Level 4 M2 L6–L7
P.5.6.4	Plan and conduct scientific investigations to test the effects of balanced and unbalanced forces on the speed and/or direction of objects in motion.		Level 3 M4 L10–L18 Level 3 M4 L28–L30
P.5.6.5	Predict how a change of force, mass, and/or friction affects the motion of an object to convert potential energy into kinetic energy.		
P.5.6.6	Design a system to increase the effects of friction on the motion of an object. Use an engineering design process to define the problem, design, construct, evaluate, and improve the system.		
Earth and Space Science			
Disciplinary Core Idea: E.5.8A Earth and the Universe			
	Astronomy is the study of celestial objects in our solar system and beyond. A solar system includes one or more suns (stars) and all other objects orbiting in that system. Planets in our night sky change positions and are not always visible from Earth as they orbit our sun. Stars that can be seen in the night sky lie beyond our solar system and appear in patterns called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation and revolution around the sun.		Level 5 M4 L1–L2 Level 5 M4 L5–L18 Level 5 M4 L20–L26
Standard E.S.8A Students will demonstrate an understanding of the locations of objects in the universe.			

E.5.8A.1	Develop and use scaled models of Earth's solar system to demonstrate the size, composition, location, and order of the planets as they orbit the Sun		
E.5.8A.2	Use evidence to argue why the sun appears brighter than other stars.		Level 5 M4 L18–L19 Level 5 M4 L24–L26
E.5.8A.3	Describe how constellations appear to move from Earth's perspective throughout the seasons.		Level 5 M4 L1–L2 Level 5 M4 L20–L26
E.5.8A.4	Construct scientific arguments to support claims about the importance of astronomy in navigation and exploration, including the use of telescopes, compasses, and star charts.		
Disciplinary Core Idea: E.5.8B Earth and the Universe			
	Earth orbits around the sun as the moon orbits around Earth. The revolution and rotation of Earth on a tilted axis provide evidence of patterns that can be observed, studied, and predicted.		Level 5 M4 L1–L2 Level 5 M4 L5–L18 Level 5 M4 L20–L26
Standard E.S.8B Students will demonstrate an understanding of the principles that govern moon phases, day and night, appearance of objects in the sky, and seasonal changes.			
E.5.8B.1	Analyze and interpret data from observations and research to explain patterns in the location, movement, and appearance of the moon throughout a month and over the course of a year.		Level 5 M4 L1–L2 Level 5 M4 L13–L17 Level 5 M4 L24–L26
E.5.8B.2	Develop and use a model of the Earth-Sun-Moon system to analyze the cyclic patterns of lunar phases, solar and lunar eclipses, and seasons.		
E.5.8B.3	Develop and use models to explain the factors that result in Earth's seasonal changes.		Level 5 M4 L22–L26
E.5.8B.4	Obtain information and analyze how our understanding of the solar system has evolved over time.		Level 5 M4 L7–L8
Disciplinary Core Idea: E.5.10 Earth's Resources			
	Human activities can impact natural processes and availability of resources. To reduce impacts on the environment (including humans), various best practices can be used. New and improved conservation practices are constantly being developed and tested.		Level 5 M3 L14–L27
Standard E.5.10 Students will demonstrate an understanding of the effects of human interaction with Earth and how Earth's natural resources can be protected and conserved.			
E.5.10.1	Collect and organize scientific ideas that individuals and communities can use to conserve Earth's natural resources and systems.		Level 5 M3 L14–L26
E.5.10.2	Design a process for better preparing communities to withstand manmade or natural disasters. Use an engineering design process to define the problem, design, construct, evaluate, and improve the disaster plan.		Level 4 M1 L12–L17

Science and Engineering Practices			**Aligned *PhD Science* Lessons**
1	Ask Questions and Define Problems • Ask questions about what would happen if a variable is changed. • Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. • Use prior knowledge to describe problems that can be solved.		Level 5 M1 L1–L2 Level 5 M2 L1–L2 Level 5 M2 L21–L23 Level 5 M3 L1–L3 Level 5 M3 L19–L23 Level 5 M4 L1–L2 Level 5 M4 L13

	• Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.		
2	Develop and Use Models • Identify limitations of models. • Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. • Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. • Develop and/or use models to describe and/or predict phenomena. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. • Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system.		Level 5 M1 L1–L2 Level 5 M1 L5–L10 Level 5 M1 L13–L14 Level 5 M1 L23–L26 Level 5 M2 L1–L2 Level 5 M2 L6–L7 Level 5 M2 L14 Level 5 M2 L20 Level 5 M3 L1–L3 Level 5 M3 L6–L16 Level 5 M3 L19–L27 Level 5 M4 L1–L4 Level 5 M4 L7–L18 Level 5 M4 L20–L26
3	Plan and Carry Out Investigations • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Evaluate appropriate methods and/or tools for collecting data. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. • Make predictions about what would happen if a variable changes. • Test two different models of the same proposed object, tool, or process to determine which better meets criteria for success.		Level 5 M1 L13–L14 Level 5 M1 L18–L22 Level 5 M2 L3–L5 Level 5 M3 L10–L11 Level 5 M4 L5–L6 Level 5 M4 L18–L19
4	Analyze and Interpret Data • Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships. • Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation. • Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings. • Analyze data to refine a problem statement or the design of a proposed object, tool, or process. • Use data to evaluate and refine design solutions.		Level 5 M1 L15–L17 Level 5 M2 L3–L5 Level 5 M2 L8–L13 Level 5 M2 L15–L17 Level 5 M3 L4–L5 Level 5 M3 L14–L16 Level 5 M4 L14–L15
5	Use Mathematics and Computational Thinking • Decide if qualitative or quantitative data are best to determine whether a proposed object or tool meets criteria for success. • Organize simple data sets to reveal patterns that suggest relationships. • Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems. • Create and/or use graphs and/or charts generated from simple algorithms to compare alternative solutions to an engineering problem.		Level 5 M1 L3–L4 Level 5 M1 L15–L22 Level 5 M3 L10–L11 Level 5 M3 L24–L27 Level 5 M4 L5–L6
6	Construct Explanations and Design Solutions • Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).		Level 5 M1 L5–L6 Level 5 M1 L11–L12 Level 5 M1 L23–L26

	• Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem. • Identify the evidence that supports particular points in an explanation. • Apply scientific ideas to solve design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.		Level 5 M2 L12–L13 Level 5 M2 L15–L17 Level 5 M2 L21–L26 Level 5 M3 L17–L23 Level 5 M4 L3–L4 Level 5 M4 L9–L12 Level 5 M4 L20–L26
7	Engage in Argument from Evidence • Compare and refine arguments based on an evaluation of the evidence presented. • Distinguish among facts, reasoned judgment based on research findings, and speculation in an explanation. • Respectfully provide and receive critiques from peers about a proposed procedure, explanation, or model by citing relevant evidence and posing specific questions. • Construct and/or support an argument with evidence, data, and/or a model. • Use data to evaluate claims about cause and effect. • Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.		Level 5 M1 L3–L4 Level 5 M2 L3–L5 Level 5 M2 L8–L11 Level 5 M2 L21–L23 Level 5 M3 L19–L23 Level 5 M4 L5–L6 Level 5 M4 L13–L17 Level 5 M4 L20–L21
8	Obtain, Evaluate, and Communicate Information • Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. • Compare and/or combine complex texts and/or other reliable media to support the engagement in other scientific and/or engineering practices. • Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices. • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. • Communicate scientific and/or technical information orally and/or in written formats, including various forms of media as well as tables, diagrams, and charts.		Level 5 M2 L6–L7 Level 5 M2 L10–L11 Level 5 M2 L18–L20 Level 5 M3 L9 Level 5 M3 L14–L16 Level 5 M3 L19–L27 Level 5 M4 L18–L19

Crosscutting Concepts			**Aligned *PhD Science* Lessons**
1	Patterns • Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products. • Patterns of change can be used to make predictions. • Patterns can be used as evidence to support an explanation.		Level 5 M1 L7–L8 Level 5 M2 L1–L5 Level 5 M2 L8–L9 Level 5 M2 L15–L17 Level 5 M3 L6–L9 Level 5 M4 L1–L17 Level 5 M4 L20–L26
2	Cause and Effect • Cause and effect relationships are routinely identified, tested, and used to explain change. • Events that occur together with regularity might or might not be a cause and effect relationship.		Level 5 M1 L1–L2 Level 5 M1 L5–L6 Level 5 M1 L9–L10 Level 5 M1 L18–L22 Level 5 M2 L3–L7

			Level 5 M2 L12–L13 Level 5 M2 L18–L23 Level 5 M3 L6–L8 Level 5 M3 L12–L18 Level 5 M4 L5–L6 Level 5 M4 L24–L26
3	Scale, Proportion, and Quantity • Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods. • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.		Level 5 M1 L3–L4 Level 5 M1 L13–L17 Level 5 M1 L23–L26 Level 5 M2 L10–L11 Level 5 M3 L1–L5 Level 5 M3 L10–L11 Level 5 M3 L24–L27 Level 5 M4 L18–L19 Level 5 M4 L24–L26
4	Systems and System Models • A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. • A system can be described in terms of its components and their interactions.		Level 5 M1 L3–L4 Level 5 M1 L15–L17 Level 5 M2 L1–L2 Level 5 M2 L6–L11 Level 5 M2 L14 Level 5 M2 L18–L19 Level 5 M2 L24–L26 Level 5 M3 L1–L9 Level 5 M3 L12–L13 Level 5 M3 L19–L27 Level 5 M4 L1–L2 Level 5 M4 L7–L23
5	Energy and Matter • Matter is made of particles. • Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems. • Energy can be transferred in various ways and between objects.		Level 5 M1 L5–L8 Level 5 M1 L13–L14 Level 5 M1 L23–L26 Level 5 M2 L6–L11 Level 5 M2 L14–L19 Level 5 M2 L24–L26 Level 5 M3 L10–L11 Level 5 M4 L3–L4
6	Structure and Function • Different materials have different substructures, which can sometimes be observed. • Substructures have shapes and parts that serve functions.		Level 3 M1 L21–L26 Level 3 M2 L1–L3 Level 3 M2 L9–L12 Level 3 M3 L4–L6 Level 3 M3 L21–L28 Level 4 M3 L4–L6 Level 4 M3 L20 Level 4 M3 L24–L25 Level 4 M3 L29–L31 Level 4 M4 L9 Level 4 M4 L24–L26
7	Stability and Change • Change is measured in terms of differences over time and may occur at different rates.		Level 5 M1 L1–L2 Level 5 M1 L9–L12 Level 5 M1 L18–L26 Level 5 M2 L12–L13

	• Some systems appear stable, but over long periods of time will eventually change.		Level 5 M2 L20 Level 5 M2 L24–L26 Level 5 M3 L14–L18 Level 5 M4 L5–L6 Level 5 M4 L9–L12