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MISSISSIPPI DEPARTMENT OF EDUCATION

Ensuring a bright future for every child

2018 Mississippi College- and Career-Readiness Standards for Science

Effective Date: 2018-2019 School Year

2018 Mississippi College- and Career-Readiness Standards for Science

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Introduction

Mission Statement

The Mississippi Department of Education is dedicated to student success, which includes improving student achievement in science, equipping citizens to solve complex problems, and establishing fluent communication skills within a technological environment. The Mississippi College- and Career-Readiness Standards provide a consistent, clear understanding of what students are expected to know and be able to do by the end of each grade level or course. The standards are designed to be robust and relevant to the real world, reflecting the knowledge and skills that students need for success in college and careers and allowing students to compete in the global economy.

Purpose

In an effort to closely align instruction for students who are progressing toward postsecondary study and the workforce, the *2018 Mississippi College- and Career-Readiness Standards for Science* includes grade- and course-specific standards for K-12 science.

This document is designed to provide K-12 science teachers with a basis for curriculum development. In order to prepare students for careers and college, it outlines what knowledge students should obtain, and the types of skills students must master upon successful completion of each grade level. The *2018 Mississippi College- and Career-Readiness Standards (MS CCRS) for Science* replaces the *2010 Mississippi Science Framework*. These new standards reflect national expectations while focusing on postsecondary success, but they are unique to Mississippi in addressing the needs of our students and teachers. The standards' content centers around three basic content strands of science: life science, physical science, and Earth and space science. Instruction in these areas is designed for a greater balance between content and process. Teachers are encouraged to transfer more ownership of the learning process to students, who can then direct their own learning and develop a deeper understanding of science and engineering practices, critical analysis, and knowledge. Doing so will produce students that will become more capable, independent, and scientifically literate adults.

Implementation

The *2018 Mississippi College- and Career-Readiness Standards (MS CCRS) for Science* will be implemented during the 2018-2019 school year.

2018 Mississippi College- and Career-Readiness Standards for Science Overview

Research and Background Information

In today's modern world and complex society, our students are required to possess sufficient knowledge of science and engineering to become vigilant consumers of scientific and technological information. To meet the growing challenges facing our future workforce, the National Research Council (NRC) published a research-based report on teaching and learning science in a 2012 document titled *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (NRC, 2012). This document proposes a new approach to K-12 science education through the integration of science and engineering practices (SEPs), crosscutting concepts, disciplinary core ideas, and engineering design within the context of science instruction.

Core Elements in the Use and Design of the *MS CCRS for Science*

The *MS CCRS for Science* are goals that reflect what a student should know and be able to do. This document does not dictate a manner or methods of teaching. The standards in this document are not sequenced for instruction and do not prescribe classroom activities, materials, or instruction strategies. These standards are end-of year expectations for each grade or course. The standards are intended to drive relevant and rigorous instruction that emphasizes student mastery of both disciplinary core ideas (concepts) and application of science and engineering practices (skills) to support student readiness for citizenship, college, and careers.

The *MS CCRS for Science* document was built by adapting and extending information from *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (NRC, 2012) and combining with Mississippi's previous science framework process strands (i.e., science as inquiry, unifying concepts and processes, science and technology, science in personal and social perspectives, and the history and nature of science). These concepts connect information across the science content strands (i.e., life science, physical science, and Earth and space science) with the disciplinary core ideas (e.g., ecology and interdependence, motions, forces, and energy, Earth systems and cycles) and are essential to both scientists and engineers because they identify common properties and processes found in practice.

The core elements are integrated across standards and performance objectives in each grade and course. A brief description of each core element is presented below.

1. Nature of Science: Science and Engineering Practices (SEPs) replaced the Inquiry Strand included in the *2010 Mississippi Science Framework*. Beyond integration within the standards, these practices must be mastered by students to produce a more scientifically literate citizenry and to develop students that are more excited about STEM (Science, Technology, Engineering, and Mathematics) topics and careers. Inquiry verbs, along with the SEPs, are woven throughout the standards, especially in the performance objectives. Each has a deliberate placement to indicate the depth of understanding expected of students.

   The practices describe the behaviors that scientists engage in as they investigate and build models and theories about the natural world. They also describe the key set of engineering practices that engineers use as they design and build models and systems. These practices work together (overlap and interconnect) and are not separated in the study and investigation of science concepts. For example, the practice of *mathematical and computational thinking* may include some aspects of *analyzing and interpreting data*. The data often come from *planning and carrying out an investigation*. The writing task force for the *MS CCRS for Science* incorporated this language into the performance objectives to emphasize the importance of a student-centered science classroom and not a teacher-centered classroom. A list of these eight practices is listed below.

a. **Ask Questions (science) and Define Problems (engineering)**
b. **Develop and Use Models**
c. **Plan and Conduct Investigations**
d. **Analyze and Interpret Data**
e. **Use Mathematical and Computational Thinking**
f. **Construct Explanations (science) and Design Solutions (engineering)**
g. **Engage in Scientific Argument from Evidence**
h. **Obtain, Evaluate, and Communicate Information**

2. Crosscutting concepts: These seven, binding concepts were adopted directly from the National Research Council's *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012) and should be woven into instruction for every grade and course. Crosscutting concepts are designed to help students see the unity of the sciences. Students often are confused when they study ecosystems for three weeks, then weather for two weeks, and finally motion and forces for several weeks. A concept is crosscutting if it communicates a scientific way of thinking about a subject and it applies to many different disciplines of science and engineering. Crosscutting concepts are sometimes called "the ties that bind." The seven concepts are listed below.

   a. **Patterns**
   b. **Cause and effect: Mechanism and explanation**
   c. **Scale, proportion, and quantity**
   d. **Systems and system models**
   e. **Energy and matter: Flows, cycles, and conservation**
   f. **Structure and function**
   g. **Stability and change**

3. Technology: If Mississippi students are to compete on a global stage and exit high school prepared for college, career, and life, technology should be used in the classroom in a way that suits 21st-century learners and reflects the modern workplace. Technology is essential in teaching and learning of science; it influences and enhances students' learning. Flexible access, customized delivery, and increased convenience for the user are core tenets. K-12 learners have fundamentally changed over the past few decades, and our classrooms should adapt to accommodate them. Dr. Ruben Puentedura's SAMR (Substitution, Augmentation, Modification, and Redefinition) model is a resource that can be considered by teachers, administrators, and technology staff as they integrate meaningful and appropriate digital learning experiences into the classroom. At the basic level, technology enhances instruction.

4. Science and society: This core element assures exploration of science's impacts on society and the feedback loop that must be cultivated and sustained to continue improvement of systems.

5. History of science: Because most modern-day scientific advancement derives from past discoveries, it is essential that students understand the breakthroughs that make today's work possible.

6. Engineering design process (EDP) is the method of devising a system, component, or process to meet desired needs. Engineering standards are represented in some performance objectives with grade-banded, specific wording that prompts educators to approach learning and exploration using the engineering process. These performance objectives are marked with an *. It is important to

note that the EDP is flexible. Most students will approach the process in various ways. The EDP is also a cycle—there is no official start or end point. Students can begin at any step, focus on just one step, move back and forth between steps, or repeat the cycle. Professional development and teacher resources will be developed for Mississippi teachers as EDP is incorporated into Mississippi standards.

Students should be provided a safe environment for failure without consequence, which is one of the most powerful drivers in learning. Providing many opportunities for students to fail, learn, and try again, with appropriate levels of support, fosters a deeper level of understanding and greater student interest and engagement.

Other Important Core Elements

Mathematics is integrated throughout the science standards document because it is essential to the scientific process, requiring students to quantify, analyze, and present results. Students must be familiar with data analysis, critical thinking, and recording their own data; students must organize and analyze it before presenting their findings. Analysis of scientific studies and publications from a quantitative perspective is also very important.

English/language arts skills are also integrated into the science standards. Students will be required to read informational text for understanding as well as process and critique information. Students must be able to articulate a critical point of view using proper terminology. In addition, the K-4 science curriculum should be increasingly tied to language arts to lay the foundation for students to have access to science before fifth grade.

Content Strands and Disciplinary Core Ideas

Science (and engineering) fields can be divided into three content-strand domains based on relative content presented in strands, extending from kindergarten to eighth grade. Grouping content in this way allows for vertical alignment of competencies and objectives to better organize content distribution. Content strands are not included in the Grades 9-12 course organization, which allows for a more logical, sequential placement and flow of content. Content strands are subdivided into 10 disciplinary core ideas in which standards and performance objectives for science content can be placed in grades K-8.

K-8 content strands with the 10 disciplinary core ideas include:

Life Science

1. Hierarchical Organization
2. Reproduction and Heredity
3. Ecology and Interdependence
4. Adaptations and Diversity

Physical Science

5. Organization of Matter and Chemical Interactions
6. Motions, Forces, and Energy

Earth and Space Science

7. Earth's Structure and History
8. Earth and the Universe
9. Earth Systems and Cycles
10. Earth's Resources

Structure of the Standards Document

The organization and structure of this standards document are as follows:

- Grade-band overview: An overview that describes the general content and themes for the grade-level band or the high school courses. Outputs and outcomes are provided along with examples of, and references to, science and engineering practices and connecting concepts.

- Grade-level or course overview: An overview that describes the specific content and themes for each grade level and/or high school course. The K-8 standards are presented with each grade focused on a grade-level theme. High school courses provide an overview of the major ideas and strategies to use when planning instruction for the course.

- Content strand: Domains into which science fields can be divided based on relative content extending from kindergarten to eighth grade. In grades K through 8, the content strands are organized into three distinct areas: (1) life science, (2) physical science, and (3) Earth and space science. For the Grade 9-12 courses, the content areas are organized around the core ideas of each course.

- Disciplinary core ideas: Subdivision of the main content strands providing recurring ideas from the three content strands. The core ideas are the key organizing principles for the development of learning units. The K-8 vertical alignment is designed in a spiral arrangement, which places emphasis on one of the three content strands in each grade level. All content strands will be found in each grade level, but all disciplinary core ideas will not be found in every grade level in K-8 due to the spiral arrangement of content.

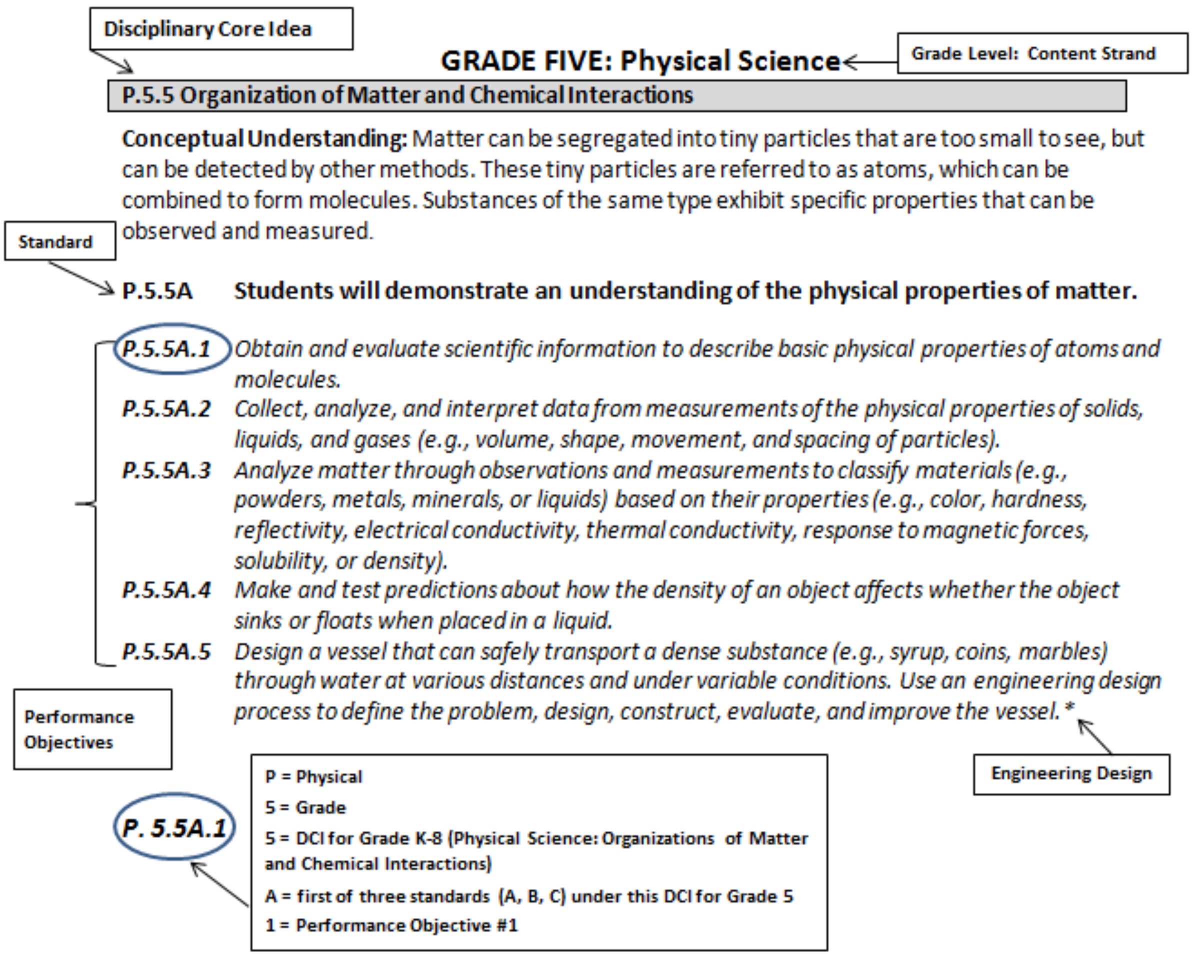
- Conceptual understanding: Statements of the core ideas for which student should demonstrate an understanding. Some grade level and/or course topics include more than one conceptual understanding with each guiding the intent of the standards.

- Content standards: Written below each disciplinary core ideas and conceptual understanding, the standards are a general statement of what students should know and be able to do because of instruction.

- Performance objectives: Detailed statements of content and skills to be mastered by the students. Performance objectives are specific statements of what students know and can do because of the science instruction at that level. These statements contain SEP and inquiry verb language.

Standards will appear in the following format:

Grade-Band Overview
Grade Level Theme (K-8)
Grade Level (K-8) or Course Overview (9-12)
Grade Level: Content Strand (K-8); Course Name (9-12)
    Disciplinary Core Idea (DCI)
    Conceptual Understanding
    Standard
    Performance Objectives



Safety in the Science Classroom

The National Science Teachers Association (NSTA) encourages K–12 school leaders and teachers to promote and support the use of science activities in science instruction and work to avoid and reduce injury. NSTA provides the following guidelines for school leaders and teachers to develop safety programs that include the effective management of chemicals, implement safety training for teachers and others, and create school environments that are as safe as possible (NSTA 2013).

1) National Science Teacher Association's *Safety in the Science Classroom*, accessible at http://www.nsta.org/docs/SafetyInTheScienceClassroom.pdf.
2) An extensive list of safety resources is available at http://www.nsta.org/safety/.

Support Documents and Resources

The MDE will develop support documents after these standards have been approved by the State Board of Education. Local districts, schools, and teachers may use these documents to construct standards-based science curriculum, allowing them to customize content to fit their students' needs and match available instructional materials. The support documents will include suggested resources, instructional strategies, essential knowledge, and detailed information about the core elements (e.g., SEPs, crosscutting concepts).

Professional development efforts will be aligned with the standards and delivered in accord with teacher resources to help expand expertise in delivering student-centered lessons (e.g., inquiry-based learning, 5-E instructional models, or other best practices in STEM teaching). The most successful national models and programs will be referenced for a capacity-building effort that can develop a more effective culture of science education in Mississippi.

Investigate, Apply, and Understand

It is important that the pedagogical paradigm of Mississippi's science classroom reflects the nature of the content being learned. The essence of science is natural to children and includes discovery, observation, questioning, design, testing, failure, iteration, and hands-on application. Research-based approaches such as inquiry-based (IB), project-based, and discovery learning are all pedagogical pathways that make sense, especially in the science classroom. Mississippi's science teachers are encouraged to embrace the growth mindset and constantly seek to upgrade classroom approaches by experimenting and adopting methods that excite students to learn and become functional, autonomous learners and contributors. Students should be provided increased maneuverability in the classroom to formulate their own ideas to investigate and understand the scientific and engineering design processes.

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GRADES 3-5 OVERVIEW

Upper elementary is a pivotal time to enhance students' scientific literacy and active engagement in science and engineering practices. Students use their experiences from structured investigations in kindergarten through Grade 2 to begin planning their own investigations to answer scientific questions. Because science foundations created at this level are key in developing students for college and career readiness, the cultivation of opportunities for inquiry-based activities and experiences that emphasize the problem solving and the engineering design process is critical.

The standards for Grades 3-5 have been developed around the following crosscutting concepts or themes:

- Grade 3 – Interactions Within an Environment
- Grade 4 – Energy and Change
- Grade 5 – Interdependence of Systems

In Grade 3, students are expected to engage in the engineering design process and conduct research and communicate their understanding of each standard in a variety of ways. In Grade 4, students will observe, research, and conduct investigations to discover patterns related to energy and change in the world around them. In Grade 5, students will model, provide evidence to support arguments, and obtain and display data about relationships among a variety of systems. Because of this yearlong study, students will gain content knowledge and tools to provide evidence and support arguments about the ways systems across content areas are interconnected and interdependent.

The core science content utilizes hands-on classroom instruction to reinforce the seven crosscutting concepts (i.e., patterns; cause and effect; scale, portion, and quantity; systems and system models; energy and matter; structure and function; and stability and change.

SEPs are in life science, physical science, and Earth and space science. The SEPs are designed so that students may develop skills and apply knowledge to solve real-life problems. While presented as distinct skill sets, the eight practices intentionally overlap and interconnect as students explore the science concepts. Some examples of specific skills students should develop in Grades 3-5 are listed below.

1. 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 (e.g., sea turtles, the dodo bird, or nocturnal species).
2. Develop and use models to explain the unique and diverse life cycles of organisms other than humans (e.g., flowering plants, frogs, or butterflies) including commonalities (e.g., birth, growth, reproduction, or death).
3. Plan and conduct scientific investigations to classify different materials as either an insulator or conductor of electricity.
4. Analyze and interpret data to describe and predict how natural processes (e.g., weathering, erosion, deposition, earthquakes, tsunamis, hurricanes, or storms) affect Earth's surface.
5. Collect, analyze, and interpret data from measurements of the physical properties of solids, liquids, and gases (e.g., volume, shape, movement, and spacing of particles).
6. Construct explanations about regional climate differences using maps and long-term data from various regions.
7. Construct scientific arguments to support claims about the importance of astronomy in navigation and exploration, including the use of telescopes, compasses, and star charts.

8. Obtain and evaluate scientific information regarding the characteristics of different ecosystems and the organisms they support (e.g., salt and fresh water, deserts, grasslands, forests, rain forests, or polar tundra lands).

Curricula and instructions that integrate science and engineering practices should reflect the skills outlined above.

The Engineering Design Process (EDP) is a step-by-step method of devising a system, component, or process to meet desired needs. This is similar to the "scientific method" which is taught to young scientists. However, the EDP is a flexible process. Students can begin at any step, focus on just one step, move back and forth between steps, or repeat the cycle. Engineering standards are represented in some performance objectives with grade-banded, specific wording that will prompt students to approach learning and exploration using the engineering process. **These performance objectives are marked with an * at the end of the statement.** Professional development and teacher resources will be developed for teachers as EDP is incorporated into Mississippi standards.

Each standard in Grades 3, 4, and 5 allows students to be active doers of science rather than passive observers of science. This approach creates an opportunity for student learning and engages the pupil in the scientific investigation process. Therefore, students need to be supplied with the appropriate resources and materials to complete scientific investigations.

E.3.9.3 *Use graphical representations to communicate the distribution of freshwater and saltwater on Earth (e.g., oceans, lakes, rivers, glaciers, groundwater, or polar ice caps).*

GRADE THREE: Earth and Space Science

E.3.10 Earth's Resources

Conceptual Understanding: 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.

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.*

E.3.10.2 *Obtain and communicate information to exemplify how humans attain, use, and protect renewable and nonrenewable Earth resources.*

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 (e.g., simulating an oil spill in the ocean or a flood in a city and creating a solution for containment and/or cleanup). Use an engineering design process to define the problem, design, construct, evaluate, and improve the environment.**

GRADE FOUR

Theme: Energy and Systems

In Grade 4, students will observe, research, and conduct investigations to discover patterns related to energy and change in the world around them. The crosscutting concept can be seen in life science through the study of human body systems, including their functions, interactions, and reliance upon other systems within the body. In physical science, the concept is developed through a study of energy in the forms of heat, light, sound, and electricity, as well as the conservation and transfer of energy from one form to another. The study of Earth science in fourth grade investigates the driving force of energy as it relates to the water cycle and changes in patterns of weather and climate. Students are expected to engage in engineering design practices, conduct research, and communicate their understanding of each standard in a variety of ways. Because of this yearlong study, students will gain research and process skills to build content knowledge that will support arguments about the ways energy and change relate to the world around us.

GRADE FOUR: Life Science

L.4.1 Hierarchical Organization

Conceptual Understanding: 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.

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.*

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 (e.g. circulatory, digestive, respiratory, muscular, skeletal, nervous) 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 (e.g. diabetes, heart disease) and infectious diseases (e.g. cold, flu) 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 (e.g. diet, exercise, vaccines, and mental health).*

GRADE FOUR: Life Science

L.4.2 Reproduction and Heredity

Conceptual Understanding: 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.

L.4.2 **Students will demonstrate an understanding of life cycles, including familiar plants and animals (e.g., reptiles, amphibians, or birds).**

L.4.2.1 *Compare and contrast life cycles of familiar plants and animals.*
L.4.2.2 *Develop and use models to explain the unique and diverse life cycles of organisms other than humans (e.g., flowering plants, frogs, or butterflies) including commonalities (e.g., birth, growth, reproduction, or death).*

GRADE FOUR: Physical Science

P.4.6 Motions, Forces, and Energy

Conceptual Understanding: 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.

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 (including burning, friction, and electricity) serve as sources of heat energy.*
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 (e.g., motion, sound, heat, or light).*
P.4.6A.4 *Develop models that demonstrate the path of an electric current in a complete, simple circuit (e.g., lighting a light bulb or making a sound).*
P.4.6A.5 *Use informational text and technology resources to communicate technological breakthroughs made by historical figures in electricity (e.g. Alessandro Volta, Michael Faraday, Nicola Tesla, Thomas Edison, incandescent light bulbs, batteries, Light Emitting Diodes).*
P.4.6A.6 *Design a device that converts any form of energy from one form to another form (e.g., construct a musical instrument that will convert vibrations to sound by controlling varying pitches, a solar oven that will convert energy from the sun to heat energy, or a simple circuit that can be used to complete a task). Use an engineering design process to define the problem, design, construct, evaluate, and improve the device.**

Conceptual Understanding: 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.

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.*
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.*

P.4.6B.4 *Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.*

Conceptual Understanding: 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.

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 (i.e., pitch and volume).*
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, (e.g., Alexander Graham Bell, Robert Boyle, Daniel Bernoulli, and Guglielmo Marconi).*

GRADE FOUR: Earth and Space Science

E.4.9 Earth's Systems and Cycles

Conceptual Understanding: 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.

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. (e.g., evaporation, condensation, precipitation, transpiration, runoff, and groundwater).*

Conceptual Understanding: 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.

E.4.9B Students will demonstrate an understanding of weather and climate patterns.

E.4.9B.1 *Analyze and interpret data (e.g., temperature, precipitation, wind speed/direction, relative humidity, or cloud types) to predict changes in weather over time.*
E.4.9B.2 *Construct explanations about regional climate differences using maps and long-term data from various regions.*
E.4.9B.3 *Design weather instruments utilized to measure weather conditions (e.g., barometer, hygrometer, rain gauge, anemometer, or wind vane). Use an engineering design process to define the problem, design, construct, evaluate, and improve the weather instrument.**

Conceptual Understanding: 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.

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 (e.g., weathering, erosion, deposition, earthquakes, tsunamis, hurricanes, or storms) affect Earth's surface.*
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 (e.g., marshes, bays, lagoons, fjord, or sound).*
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.*
E.4.9C.4 *Research and explain how systems (i.e., the atmosphere, geosphere, and/or hydrosphere), interact and support life in the biosphere.*
E.4.9C.5 *Obtain and communicate information about severe weather phenomena (e.g., thunderstorms, hurricanes, or tornadoes) to explain steps humans can take to reduce the impact of severe weather events.*

GRADE FOUR: Earth and Space Science

E.4.10 Earth's Resources

Conceptual Understanding: 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.

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, non-renewable resources (e.g. coal, crude oil, wood).*
E.4.10.2 *Use technology or informational text to investigate, evaluate, and communicate various forms of clean energy generation.*