SC EDUCATION OVERSIGHT COMMITTEE
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AGENDA

Academic Standards and Assessments Subcommittee Meeting

Monday, May 17, 2021
Blatt Building, Room 443
10:00 A.M.

I. Welcome .... Neil Robinson

II. Approval of ASA Minutes, March 15, 2021 .... Neil Robinson

III. *Action Items:*
SC CCR Science Academic Standards, 2021................. Dr. Rainey Knight
(printed copies provided to members on April 12, 2021)

Military Connected Students Report, 2021 ....Dr. Valerie Harrison

Parent Survey Report, 2020..Dr. Kevin Andrews

IV. Adjournment

Academic Standards and Assessments
Neil Robinson, Vice Chair
Barbara Hairfield
Sen. Greg Hembree
Sidney Locke
Patti Tate
Dr. Scott Turner

SOUTH CAROLINA EDUCATION OVERSIGHT COMMITTEE

Academic Standards and Assessments (ASA) Subcommittee Meeting

Minutes of the Meeting

March 15, 2021

Members Present (in-person or remote): Neil Robinson, Subcommittee Chair; Barbara Hairfield; and Sen. Greg Hembree;

EOC Staff Present: Dr. Kevin Andrews; Matthew Ferguson; Dr. Valerie Harrison; Hope Johnson-Jones; Dr. Rainey Knight; and Dana Yow.

Mr. Robinson welcomed members. The minutes from the Joint ASA and Public Awareness Subcommittee meeting on January 25, 2021 were approved as submitted. Mr. Robinson called upon Dr. Andrews to present the ECENC Report. Mr. Ferguson pointed out the staff recommendation that addresses students in the ECENC program taking state assessments.

Sen. Hembree asked about whether private schools would pay for state tests administered. We would need to look at a process to make these tests available to these students, since they are not available now. Sen. Hembree stated that we spend a lot of time and effort on test security. He asked if we have examples of real security breaches that impacted huge amounts of students. Dr. Andrews stated we are supposed to have multiple test forms and we need a larger item pool.

Ms. Hairfield stated that as for test security, there has been a lot of dialogue about extending test windows. If the state moved to performance-based assessments, that would take care of a lot of the problems. Assessment is going to have to move toward the digital environment.

Due to a quorum not being present, action was deferred on the ECENC Report.

Mr. Ferguson then presented an update to the Remote Learning Data project, Part 3 which includes Fall/Winter 2020 formative assessment analysis. The COVID decline in median percentile from 2019-20 to 2020-21 is larger in math than in reading. The overall median percentile results for math and reading are similar in Winter 2021. For math, the largest drop occurred from Winter 2020 to Fall 2020, with a small drop from Fall 2020 to Winter 2021. For reading, a smaller drop occurs from Winter 2020 to Fall 2020, but median percentiles continue to decline to Winter 2021.

Sen. Hembree asked if we have seen reported data from other states; in our data, it seems like math bottoms out before reading. Mr. Ferguson stated that we are better positioned in SC to look at trends, since students were required to be administered formative assessments in Act 142. Sen. Hembree stated that he was more concerned about missing kids. It is advisable to continue to collect data. These are taxpayer funded assessments. He wondered if there was a counter argument to not reporting these data to the EOC and SCDE, or if turning over such data was an onerous task for districts. Mr. Ferguson stated these data were already collected by testing vendors.

Sen. Hembree also asked if we could separate out the data based on whether a child was in-person, hybrid, or virtual. Mr. Ferguson said he we cannot do that at this time; school districts have not been consistent in their attendance coding. We may be able to look at the administration of a test, but the mode of instruction is much more important to capture.

Ms. Hairfield asked if we have looked at non-MAP data. Mr. Ferguson said that this report focused on NWEA MAP data; however, the overall implications are not different.

Finally, Mr. Ferguson gave his Executive Director's update. He summarized a recent letter from the USDE that reacted to the SCDE request to waive summative tests this year, in favor of using formative tests. He also mentioned that staff is talking to the SCDE about coming up with a process by which dual credit courses used for college-readiness are approved. In May, the ASA subcommittee will be considering science standards.

There being no further business, the meeting adjourned.

EDUCATION OVERSIGHT COMMITTEE

Subcommittee: **Academic Standards and Assessments**

Date: **May 17, 2021**

ACTION ITEM
Approval of South Carolina 2021 South Carolina College and Career Ready Science Standards

PURPOSE/AUTHORITY
SECTION 59-18-320, 59-18-325, 59-18-360 of the Education Accountability Act require the EOC to approve all standards and assessments used for accountability. In addition, all standards must be reviewed cyclically and at a minimum every seven years.

CRITICAL FACTS
The South Carolina Department of Education (SCDE) has completed revisions to the South Carolina Academic Standards and Performance Indicators for Science 2014. Attached are the SC 2021 South Carolina College and Career Ready Science Standards as revised by the SCDE.

TIMELINE/REVIEW PROCESS

May-November 2019	EOC conducted cyclical review of the South Carolina Academic Standards and Performance Indicators for Science 2014
December 16, 2019	EOC approved Cyclical Review Report on South Carolina Academic Standards and Performance Indicators for Science 2014
January - December 2020	SCDE revised 2014 Science Standards
February 9, 2021	SC State Board of Education approved 2021 South Carolina College and Career Ready Science Standards for 1st reading
May 11, 2021	SC State Board of Education expected to approve science standards for 2nd reading

ECONOMIC IMPACT FOR EOC

Cost: **None**

Fund/Source: EIA

ACTION REQUEST

☒ **For approval** ☐ **For information**

ACTION TAKEN

☐ **Approved** ☐ **Amended**
☐ **Not Approved** ☐ **Action deferred (explain)**

STATE OF SOUTH CAROLINA

DEPARTMENT OF EDUCATION

MOLLY M. SPEARMAN

STATE SUPERINTENDENT OF EDUCATION

SECRETARY TO THE STATE BOARD OF EDUCATION

South Carolina College- and Career-Ready Science Standards 2021

South Carolina State Board of Education

February 9, 2021

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Acknowledgements

South Carolina owes a debt of gratitude to the hundreds of science educators, informal science educators, representatives of higher education, business and industry representatives, community members and leaders, parents, national science education leaders, as well as recent SC graduates who collaborated to produce the *South Carolina College- and Career-Ready Science Standards 2021*.
See Appendix A for list of all committee, panel, and team members.

SC Education Oversight Committee (EOC) Science Standards Review Panel
The 5 members of the SC EOC science standards national review panel and 43 members of the state review panel recommended revisions to the *South Carolina Academic Standards and Performance Indicators for Science 2014.*

SCDE Science Standards Review Panel
The 54 members of the SCDE science standards review panel recommended revisions to the *South Carolina Academic Standards and Performance Indicators for Science 2014.*

SCDE Writing Team
The 49 members of the SCDE science standards writing team wrote the *South Carolina College- and Career-Ready Science Standards 2021*.

SCDE Local Writing Advisory Team
The 28 members of the SCDE local advisory writing team provided recommendations to the *writing team.*

SCDE National Advisory Writing Team
The 10 members of the SCDE national advisory writing team provided recommendations to the *writing team.*

SCDE Standards Design Team
The 13 members of the SCDE design team produced the engineering design process for the *South Carolina College- and Career-Ready Science Standards 2021*.

South Carolina Department of Education
The standard document writers developed this document under the direction of Dr. David Mathis, Deputy Superintendent, Division of College & Career Readiness; Dr. Anne Pressley, Director, Office of Standards and Learning; Gwendolynn Shealy, Team Lead and Elementary Science Education Associate, Office of Standards and Learning; Kathryn Stabell, Secondary Science Education Associate; Kirsten Hural, Program Manager End-of-Course Examination Program, Office of Assessment; and Brenda Ponsard, Science Education Associate, Office of Assessment.

Introduction to the *South Carolina College- and Career-Ready Science Standards 2021*

South Carolina's Vision for Science Education

Beginning in Kindergarten and extending each year through 12th grade, all students will be provided with a coherent K-12 progression of authentic and relevant learning experiences where they actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of each field's disciplinary core ideas.

South Carolina students will build readiness for college, career, and lifelong learning through the integration of the three dimensions into standards, curriculum, instruction, and local and state assessment, and through the feature of engineering and technology alongside of natural sciences (physical science, life sciences, and Earth and space sciences).

South Carolina students will be prepared to:

- carefully consume scientific and technological information related to their everyday lives,
- engage in public discussions on science-related issues,
- be a civic-minded decision-maker,
- appreciate the beauty and wonder of science,
- make sense of everyday phenomena, and
- identify creative solutions to local, national, and global problems.

"Although the intrinsic beauty of science and a fascination with how the world works have driven exploration and discovery for centuries, many of the challenges that face humanity now and, in the future, related, for example, to the environment, energy, and health—require social, political, and economic solutions that must be informed deeply by knowledge of the underlying science and engineering" **(NRC, 2012, p.7).**

Academic Standards

The standards are performance expectations that are three-dimensional. These three dimensions are:

- **Science and Engineering Practices (SEPs)**,
- **Disciplinary Core Ideas (DCIs)**, and
- **Crosscutting Concepts (CCCs)**.

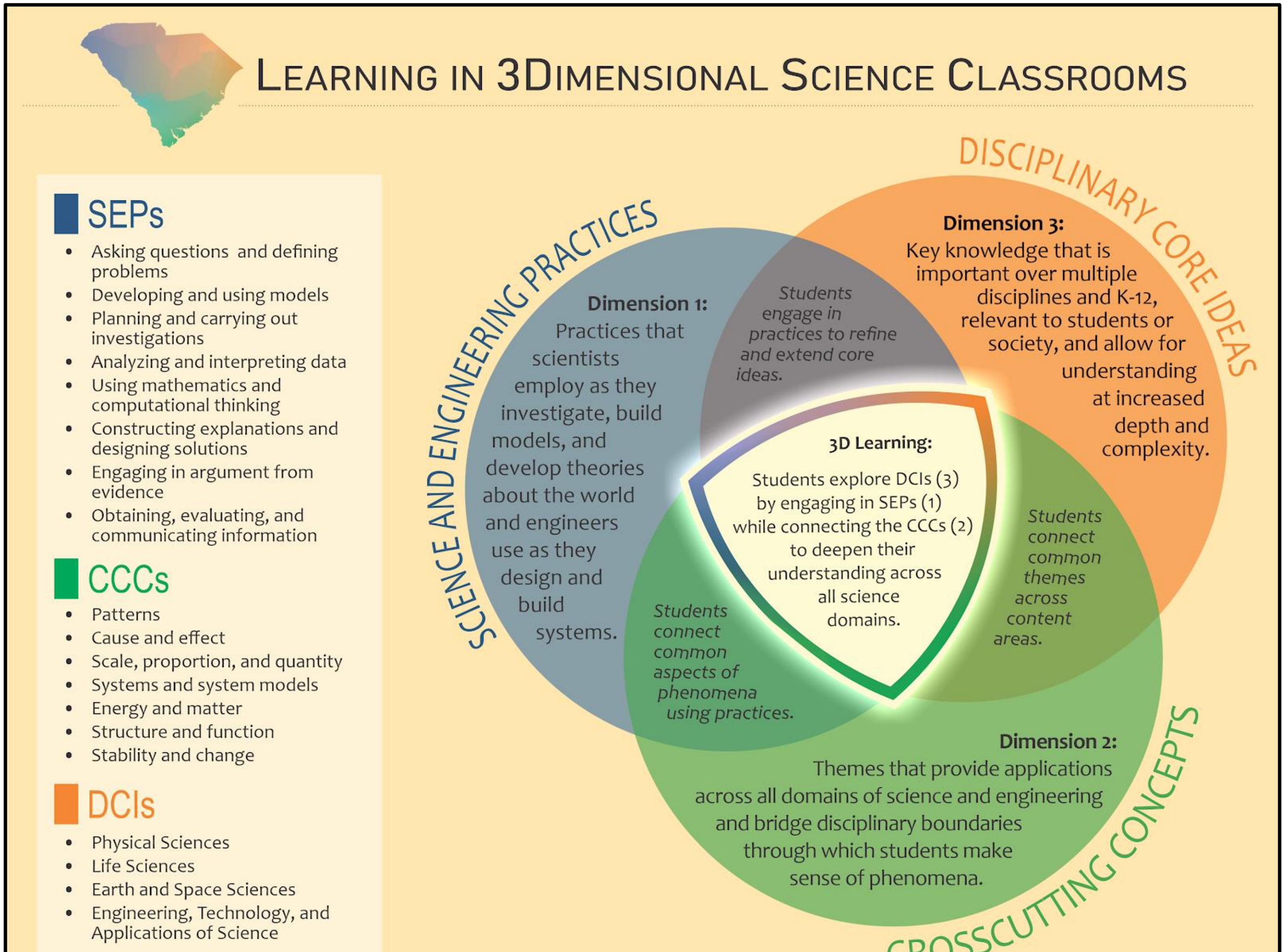
The standards derive from foundational research that ensures in-depth opportunities for students to authentically explore the core ideas of the natural and human built world as scientists and engineers.

The standards are considered flexible for the organization of any course as they are not sequenced for instruction and do not represent a curricular scope or sequence. The three-dimensional standards describe a small number of disciplinary core ideas, so that all students learn what is most important for proficiency in the discipline at a particular level.

In accordance with the South Carolina Educational Accountability Act of 1998 (S.C. Code Ann. § 59- 18-110), the purpose of academic standards is to provide the basis for the development of local curricula and statewide assessment.

The *South Carolina College- and Career-Ready Science Standards 2021* was informed by A Framework for K-12 Science Education [NRC Framework] (2012), the Next Generation Science Standards, other states' standards, and the Profile of the South Carolina Graduate.

Learning in 3 Dimensional Science Classrooms



Adapted from Houseal (2016) & NRC Framework (2012).

Dimension 1: Science and Engineering Practices

The **Science and Engineering Practices (SEPs)** are the major practices that scientists apply as they investigate and build models and theories about the world, and that engineers use as they design and build systems. Students should not learn about these practices secondhand, in an isolated unit, or apart from the other two dimensions. While one **SEP** is identified to be assessable and represents the student performance goal for the end of instruction, other **SEPs** should be applied by students to support their progress leading up to the end of instruction. This is vital, as the fields of science and engineering are related and mutually supportive through the eight **SEPs** that students **DO** (NRC Framework, 2012, p. 50-53).

Asking Questions and Defining Problems

Scientists ask and refine questions about phenomena that lead to explanations of how the natural and designed world(s) works.
Engineers ask questions to define the problems, identify constraints, and determine criteria for an effective solution.

Use Mathematical and Computational Thinking

Scientists use mathematics and computation as tools for representing physical variables and their relationships.
Engineers use mathematical and computational representations of established relationships and principles as an integral part of design.

Developing and Using Models

Scientists construct and use models to help develop and understand explanations about natural phenomena.
Engineers use models as helpful tools to test proposed systems and to recognize strengths and limitations of new designs.

Constructing Explanations and Designing Solutions

Scientists construct logically coherent explanations of phenomena that are consistent with the available evidence.
Engineers' designs are based on scientific knowledge and models of the material world.

Planning and Carrying out Scientific Investigations

Scientists use observations and data collected to test existing theories and explanations or to revise and develop new ones.
Engineers use investigations to gain data to specify design criteria and to test their designs.

Engaging in Argument from Evidence

Scientists identify the strengths and weaknesses of a line of reasoning to engage in argument for finding the best explanation of a natural phenomenon.
Engineers engage in argument from evidence to find the best possible solution to a problem.

Analyzing and Interpreting Data

Scientists use a range of tools to identify the significant features and patterns in data.
Engineers use a range of tools and analyze data collected in the tests of their designs and investigations.

Obtaining, Evaluating, and Communicating Information

Scientists derive meaning from texts and evaluate the validity of information to then communicate ideas.
Engineers derive meaning from other's work and texts and evaluate the information, to apply it usefully to express their ideas.

Link to the grounding research for the **SEPs** from the NRC Framework.

Dimension 2: Crosscutting Concepts

The **Crosscutting Concepts** (**CCCs**) represent seven themes that span across science domains (Physical, Life, Earth and Space, and Engineering, Technology, and Applications of Science) and have value to both scientists and engineers as they identify and connect universal properties and processes found in all domains. Students should not learn about these concepts secondhand, in an isolated unit, or apart from the other two dimensions. While one **CCC** is identified to be assessable and represents the student performance goal for the end of instruction, other **CCCs** could be applied by students to support their progress leading up to the end of instruction. The **CCCs** give students an organizational framework for connecting knowledge from the various disciplines into a coherent and scientific based view of the world (NRC Framework, 2012, 83-102).

Patterns

Students observe patterns of forms and events to guide organization and classification. Patterns prompt student questions about the factors that influence cause-and-effect relationships and are useful as evidence to support student explanations and arguments.

Systems and System Models

Students define the system(s) under study by specifying its boundaries and making explicit a model of the system(s). By doing so, the students are provided tools for understanding and testing ideas that are applicable throughout science and engineering.

Cause and Effect

Students investigate and explain causal relationships and the mechanisms by which they are mediated. Events have causes, some simple, some multifaceted and complex. Students can test such mechanisms across given contexts and the mechanisms can be used to predict and explain events in new contexts.

Energy and Matter

Students understand the system's possibilities and limitations by tracking fluxes of energy and matter into, out of, and within systems.

Scale, Proportion, Quantity

Students, while considering phenomena, come to recognize what is relevant at different measures of size, time, and energy, and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Structure and Function

Students observe an object or living thing's structure and shape to determine many of its properties and functions. The functioning of natural and built systems both depend on the shapes and relationships of certain key parts and on the properties of the materials from which they are made.

Stability and Change

Students recognize the conditions of stability and rates of change for natural and built systems to develop an understanding of how the system operates and causes for changes in systems.

Link to the grounding research for the **CCCs** from the NRC Framework.

Dimension 3: Disciplinary Core Ideas

Disciplinary Core Ideas (**DCIs**) are a set of four science and engineering domains for K–12 science that have broad importance across multiple science and engineering disciplines. The **DCIs** provide a tool for understanding or investigating more complex ideas and solving problems, relate to the interests and life experiences of students, and are learnable over multiple grades at increasing levels of depth and sophistication. Students should not memorize or learn isolated facts about the **DCIs** secondhand or apart from the other two dimensions (NRC Framework, 2012, p. 31).

Physical Science (PS)

PS1: Matter and its interactions
PS2: Motion and stability: Forces and interactions
PS3: Energy
PS4: Waves and their applications in technologies for information transfer

Students gain awareness of the structure of matter, interactions occurring in terms of the forces between objects, related energy transfers, and their consequences to understand the physical and chemical basis of a system. Chemistry and physics underlie all natural and human-created phenomena and helps students see the mechanisms of cause and effect in all systems and processes that are understood through a common set of physical and chemical principles.

Life Science (LS)

LS1: From molecules to organisms: Structures and processes
LS2: Ecosystems: Interactions, energy, and dynamics
LS3: Heredity: Inheritance and variation of traits
LS4: Biological evolution: Unity and diversity

Students focus on patterns, processes, and relationships of living organisms. The study of life ranges over scales from single molecules, organisms, and ecosystems, to the biosphere. A core principle of the life sciences is that organisms are related through common ancestry and that processes of natural selection have led to the tremendous diversity on Earth. Students in life science courses explore all aspects of living things and the environments they live in.

Earth and Space Science (ESS)

ESS1: Earth's place in the universe
ESS2: Earth's systems
ESS3: Earth and human activity

Students investigate processes that operate on Earth and address Earth's place in the universe. Earth and space science involve phenomena that range in scale from unimaginably large to invisibly small. Earth and space sciences also provide students opportunities to understand how the atmosphere, geosphere, and biosphere are interconnected.

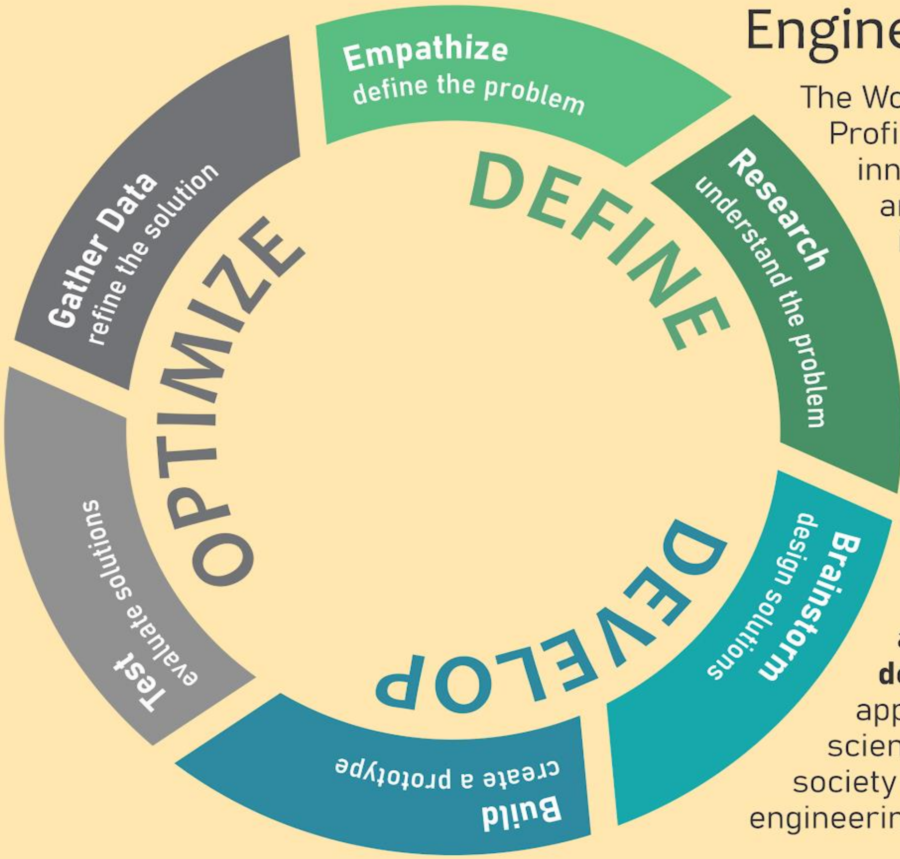
Engineering, Technology, and Applications of Science (ETS)

ETS1: Engineering design
ETS2: Links among engineering, technology, science, and society

Students learn how science is utilized, through the engineering design process, and have the opportunity to appreciate the distinctions and relationships between engineering, technology, and applications of science alongside the physical, life, and Earth and space sciences of other core idea domains. Science-based designs of technologies and systems affect the ways in which people interact with each other and with the environment, indicating how these designs deeply influence society.

Link to the grounding research for the **DCIs** from the NRC Framework: PS, LS, ESS, and ETS.

Engineering, Technology, and Applications of Science: Engineering Design Process



Engineering Design Process:

The World Class Skills as articulated in the Profile of the SC Graduate: creativity and innovation, critical thinking, collaboration and teamwork, and communication are infused in the **engineering design process** to support student development of both individual and cooperative engineering practices. During the iterative process, students **define** problems to **develop** and **optimize** solutions to local, national, and global issues. The fields of science and engineering are related and mutually supportive and by engaging students in the knowledge and practices related to the **engineering design process**, students establish an appreciation for the interdependence of science, engineering, and technology within society and the natural world and view engineering as a possible career path.

ETS1: This icon found within the PE aligns to ETS1 and notes where students engage directly in the engineering design process.

ETS2: This icon found within the DCI box shows learning connections to ETS2 - Links Among Engineering, Technology, and Society.

Link to the grounding research for the **ETS** from the NRC Framework.[12]

Science Dimensions Overview

The *South Carolina College- and Career-Ready Science Standards 2021* are three-dimensional **Performance Expectations (PEs)** that include a **Science and Engineering Practice (SEP)**, **Disciplinary Core Ideas (DCIs)**, and a **Crosscutting Concept (CCC)**.

ETS1 — This icon found within the PE aligns to ETS1 and notes where students engage directly in the engineering design process.

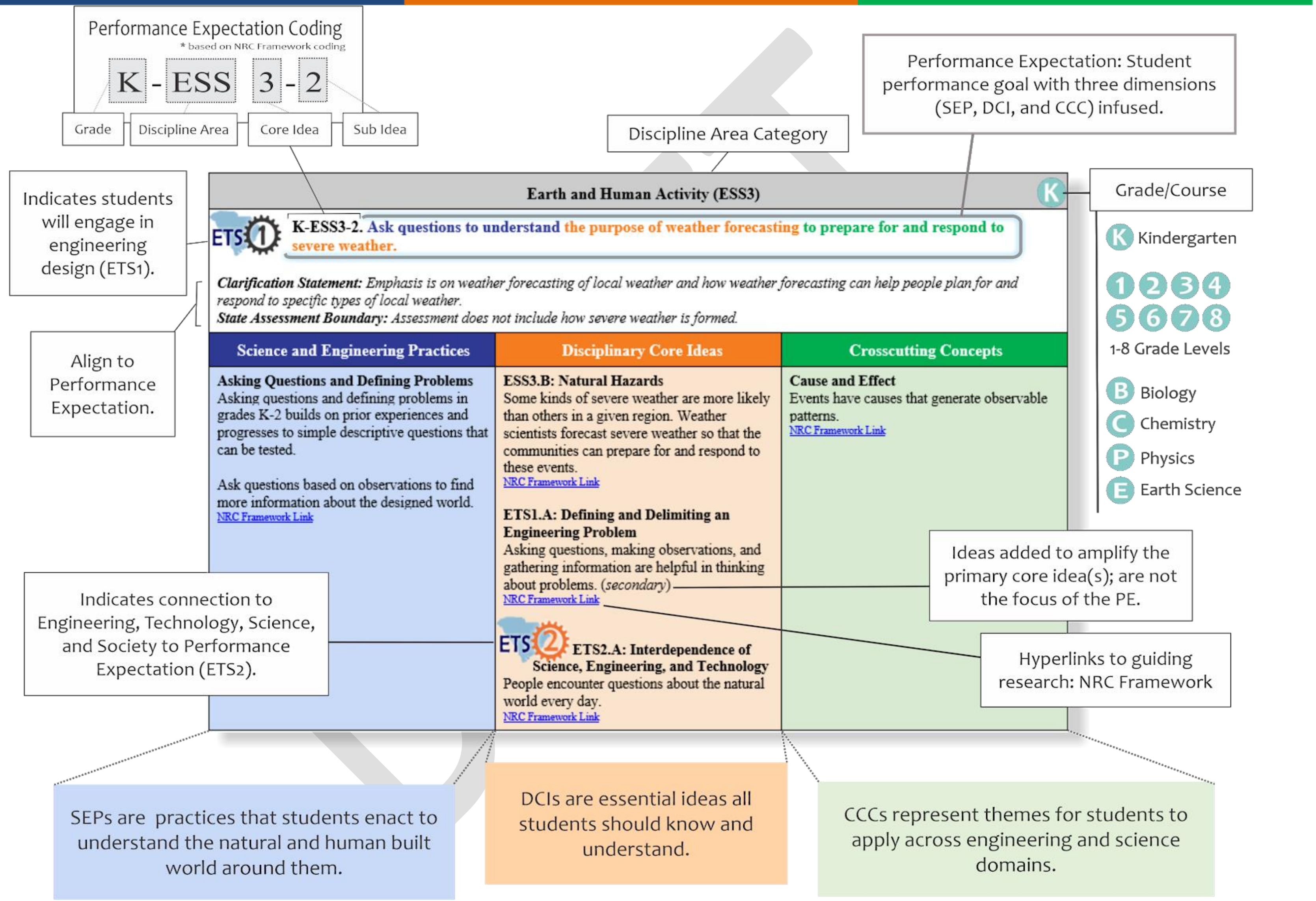
Performance Expectation (PE): The standard that represents the three-dimensional end-of-instruction goal aligned to what students should know, understand, and be able to perform to show proficiency in science and engineering. Each **PE** contains one **SEP** and one **CCC** to be assessable; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction.

Clarification Statement*:* Where needed, a clarification statement accompanies a **PE**. The intent of a clarification statement is to provide further explanation or examples to better support educators in understanding the aim of the **PE**.
State Assessment Boundary*:* Where needed, an assessment boundary accompanies a **PE**. The intent of assessment boundaries found in K-12 **PEs** is to clarify limits to the state large-scale three-dimensional assessments in response to any legislative changes to tested grades. Instruction and local assessments are not limited by this boundary.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
	*Some DCI ideas are listed as (*secondary)* and are ideas added to the DCI to amplify the primary core idea(s), but are not meant to be the focus of the PE. ETS2 — This icon found within the DCI box shows learning connections to ETS2: Links Among Engineering, Technology, and Society.	

Foundation Boxes: When viewed in tandem with PEs, the foundation boxes provide a more coherent and complete view of what students should be able to do. When students explore disciplinary core ideas (Dimension 3), they will do so by engaging in practices (Dimension 1) and should be supported in making connections to the crosscutting concepts (Dimension 2) to link their understanding across the four disciplinary core domains.

Understanding the Architecture of the Standards



Kindergarten

South Carolina kindergarten students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The performance expectations in kindergarten help students engage in inquiry questions such as, **but not limited to:**

What happens if you change how hard you push or pull an object?

Students plan and conduct investigations to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze data to design solutions.

Where do animals and plants live and why do they live there?

Students develop an understanding of what plants and animals (including humans) need to survive and use models to understand the relationship between their needs and where they live.

What is the weather like today and how is it different from yesterday?

Students ask questions and share observations to develop an understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for and respond to severe weather.

What can observations tell us about the effect of sunlight on Earth's surface?

Students apply an understanding of sunlight's effect on the Earth's surface to design solutions to reduce the sunlight's warming effect on an area.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Kindergarten

Through the kindergarten performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In kindergarten, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
• Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS2, PS3) • Life Science (LS1) • Earth and Space Science (ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Systems and System Models

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Motion and Stability: Forces and interactions (PS2)

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

Clarification Statement: *Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.*
State Assessment Boundary: *Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. With guidance, plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. NRC Framework Link	**PS2.A: Forces and Motion** Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. NRC Framework Link **PS2.B: Types of Interactions** When objects touch or collide, they push on one another and can change motion. NRC Framework Link **PS3.C: Relationship Between Energy and Forces** A bigger push or pull makes things speed up or slow down more quickly. NRC Framework Link	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. NRC Framework Link

Motion and Stability: Forces and interactions (PS2)

K

K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

Clarification Statement: *Emphasis on exploration-based play as a means to test objects or tools to determine if they work as intended. Examples of solutions could include tools such as a ramp to increase the speed of the object or a structure that would cause an object, such as a marble or ball, to turn.*
State Assessment Boundary: *Assessment does not include friction as a mechanism for change in speed.*

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Analyze data from tests of an object or tool to determine if it works as intended. NRC Framework Link	**PS2.A: Forces and Motion** Pushes and pulls can have different strengths and directions. Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. NRC Framework Link **ETS1.A: Defining and Delimiting an Engineering Problem** A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** There are many types of tools produced by engineering that can be used in science to help answer these questions through observation or measurement. Observations and measurements are also used in engineering to help test and refine design ideas. NRC Framework Link	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. NRC Framework Link

Energy (PS3)

K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface.

Clarification Statement: *Examples of Earth's surface could include sand, soil, rocks, and water.*
State Assessment Boundary: *Assessment of temperature is limited to relative measures such as warmer/cooler.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Make observations (firsthand or from media) to collect data that can be used to make comparisons. NRC Framework Link	**PS3.B: Conservation of Energy and Energy Transfer** Sunlight warms Earth's surface. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

Energy (PS3)		
K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.		
Clarification Statement: *Structures could incorporate shade, color, and materials that minimize the warming effects of the sun.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Cross Cutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. NRC Framework Link	**PS3.B: Conservation of Energy and Energy Transfer** Sunlight warms Earth's surface. NRC Framework Link **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** There are many types of tools produced by engineering that can be used in science to help answer these questions through observation or measurement. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

Molecules to Organisms: Structures and Processes (LS1)

K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive.

Clarification Statement: *Examples of patterns could include that animals need to take in food, but plants make food; the different kinds of food needed by different types of animals; the requirement of plants to have light; and that all living things need water. Patterns could be described using multiple modes of representation.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

Earth's Systems (ESS2)

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time.

Clarification Statement: *Examples of qualitative observations could include descriptions of the weather (sunny, cloudy, rainy, or warm). Examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that mornings are cooler than afternoons and the number of sunny days versus cloudy days during different months.*
State Assessment Boundary: *Assessment of quantitative observations are limited to whole numbers and relative measures such as warmer/cooler.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**ESS2.D: Weather and Climate** Weather is the combination of sunlight, wind, snow, or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. NRC Framework Link	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. NRC Framework Link

Earth's Systems (ESS2)		
K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. ***Clarification Statement:*** *Examples of plants and animals changing their environment could include beavers building dams, a squirrel digging in the ground to hide its food, and tree roots breaking concrete. Humans have developed means to heat and/or cool our homes and vehicles to protect ourselves from the elements.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). Construct an argument with evidence to support a claim. NRC Framework Link	**ESS2.E: Biogeology** Plants and animals depend on and can change their environment. NRC Framework Link **ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (*secondary*) NRC Framework Link	**Systems and System Models** Systems in the natural and designed world have parts that work together. NRC Framework Link

Earth and Human Activity (ESS3)

K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.

Clarification Statement: *Examples of relationships could include that deer eat buds and leaves; therefore, they usually live in forested areas, humans use soil and water to grow food, and grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.*
State Assessment Boundary: *Assessment does not include specific habitats or biomes.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e. diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. Use a model to represent relationships in the natural world. NRC Framework Link	**ESS3.A: Natural Resources** Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. NRC Framework Link	**Systems and System Models** Systems in the natural and designed world have parts that work together. NRC Framework Link

Earth and Human Activity (ESS3)

K-ESS3-2. Ask questions to understand the purpose of weather forecasting to prepare for and respond to severe weather.

Clarification Statement: *Emphasis is on weather forecasting of local weather and how weather forecasting can help people plan for and respond to specific types of local weather.*
State Assessment Boundary: *Assessment does not include how severe weather is formed.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades K-2 builds on prior experiences and progresses to simple descriptive questions that can be tested. Ask questions based on observations to find more information about the designed world. NRC Framework Link	**ESS3.B: Natural Hazards** Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. NRC Framework Link **ETS1.A: Defining and Delimiting an Engineering Problem** Asking questions, making observations, and gathering information are helpful in thinking about problems. (*secondary*) NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** People encounter questions about the natural world every day. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

Earth and Human Activity (ESS3)

K-ESS3-3. Obtain and communicate information to define problems related to human impact on the local environment.

Clarification Statement: *Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of human choices could include reusing and recycling materials.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information. Communicate information with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them, but they can make choices that reduce their impacts on the land, water, air, and other living things. NRC Framework Link **ETS1.A: Defining and Delimiting an Engineering Problem** Asking questions, making observations, and gathering information are helpful in thinking about problems. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

First Grade

South Carolina first-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The performance expectations in first grade help students engage in inquiry questions such as, **but not limited to:**

What happens when there is no light?

Students investigate the relationship between the presence or absence of light and the ability to see objects. The idea that light travels from place to place can be understood by students at this level through determining the effect of placing objects made with different materials in the path of a beam of light.

What are some ways plants and animals meet their needs in order to survive and grow?

Students develop an understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs as well as how behaviors of parents and offspring help the offspring survive. Students also us mimicry to design solutions to a human problem.

What happens when materials vibrate?

Students plan and conduct investigations to develop an understanding of the relationship between sound and vibrating materials.

How are parents and their young similar and different?

Students make observations to support the understanding that young plants and animals are like, but not exactly the same as, their parents.

What objects are in the sky and how do they seem to move?

Students are able to observe, describe, and predict some patterns of the movement of objects in the sky.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

First Grade

Through the first-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In first grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS4) • Life Science (LS1, LS3) • Earth and Space Science (ESS1) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Systems and System Models • Structure and Function

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Waves and their Applications in Technologies for Information Transfer (PS4)		
1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. ***Clarification Statement:*** *Examples of vibrating materials that make sound could include tuning forks and a stretched string that is plucked. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. NRC Framework Link	**PS4.A: Wave Properties** Sound can make matter vibrate and vibrating matter can make sound. NRC Framework Link	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. NRC Framework Link

Waves and their Applications in Technologies for Information Transfer (PS4)		
1-PS4-2. Make observations to support an evidence-based claim that objects in darkness can be seen only when illuminated by light sources. ***Clarification Statement:*** *Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. NRC Framework Link	**PS4.B: Electromagnetic Radiation** Objects can only be seen if light is available to illuminate them or if they give off their own light. NRC Framework Link	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. NRC Framework Link

Waves and their Applications in Technologies for Information Transfer (PS4)

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.

Clarification Statement: *Examples of materials could include clear plastic (transparent), wax paper (translucent), cardboard (opaque), and mirrors (reflective).*
State Assessment Boundary: *Assessment does not include the speed of light, or the terms transparent, translucent, opaque, and reflective.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. NRC Framework Link	**PS4.B: Electromagnetic Radiation** Light travels from place to place. Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. NRC Framework Link	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. NRC Framework Link

Waves and their Applications in Technologies for Information Transfer (PS4)

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to communicate over a distance.

State Assessment Boundary: *Assessment does not include technological details for how communication devices work.*

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

Use tools and materials provided to design a device that solves a specific problem.
NRC Framework Link

Disciplinary Core Ideas

PS4.C: Information Technologies and Instrumentation
People also use a variety of devices to communicate (send and receive information) over long distances.
NRC Framework Link

ETS1.B: Developing Possible Solutions
Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. To design something complicated, one may need to break the problem into parts and attend to each part separately, then bring the parts together to test the overall solution.
NRC Framework Link

ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World
Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world.
NRC Framework Link

Crosscutting Concepts

Systems and System Models
Systems in the natural and designed world have parts that work together.
NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.

Clarification Statement: *Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, or animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches or animal quills; or detecting intruders by mimicking eyes or ears.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use materials to design a device that solves a specific problem or a solution to a specific problem. NRC Framework Link	**LS1.A: Structure and Function** All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. NRC Framework Link **LS1.D: Information Processing** Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. NRC Framework Link **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. NRC Framework Link (continued on next page)	**Structure and Function** The shape and stability of structures and natural and designed objects are related to their function(s). NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. [NRC Framework Link]	

From Molecules to Organisms: Structures and Processes (LS1)

1-LS1-2. Obtain information from multiple sources to determine patterns in parent and offspring behavior that help offspring survive.

Clarification Statement: *Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, or other vocalizations) and the responses of the parents (such as feeding, comforting, or protecting the offspring). Information may be obtained through observation, field study, text, media, etc.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information. Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. NRC Framework Link	**LS1.B: Growth and Development of Organisms** Adult plants and animals can have young. In many kinds of animals, parents, and the offspring themselves engage in behaviors that help the offspring to survive. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)		
1-LS3-1. Make observations to support an evidence-based claim that most young are like, but not exactly like, their parents. ***Clarification Statement:*** *Emphasis is on identifying patterns of shared features between young and adult plants or animals. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size, and a particular breed of dog looks like its parents but is not exactly the same.* ***State Assessment Boundary:*** *Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. NRC Framework Link	**LS3.A: Inheritance of Traits** Young animals are very much, but not exactly, like their parents. Plants also are very much, but not exactly, like their parents. NRC Framework Link **LS3.B: Variation of Traits** Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. NRC Framework Link	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. NRC Framework Link

Earth’s Place in the Universe (ESS1)

1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.

Clarification Statement: *Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.*
State Assessment Boundary: *Assessment of star patterns is limited to stars being seen at night and not during the day.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**ESS1.A: The Universe and Its Stars** Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** People encounter questions about the natural world every day. There are many types of tools produced by engineering that can be used in science to help answer these questions through observation or measurement. Observations and measurements are also used in engineering to help test and refine design ideas. NRC Framework Link	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. NRC Framework Link

Earth's Place in the Universe (ESS1)		
1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year. ***Clarification Statement:*** *Emphasis is on relative comparisons of the amount of daylight in the winter or summer to the amount in the spring or fall.* ***State Assessment Boundary:*** *Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Make observations (firsthand or from media) to collect data that can be used to make comparisons. NRC Framework Link	**ESS1.B: Earth and the Solar System** Seasonal patterns of sunrise and sunset can be observed, described, and predicted. NRC Framework Link	**Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. NRC Framework Link

Second Grade

South Carolina second-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The performance expectations in second grade help students engage in inquiry questions such as, **but not limited to:**

How are materials similar and different from one another, and how do the properties of the materials relate to their use?

Students develop an understanding of observable properties of materials through the analysis and classification of different materials.

How does land change and what are some things that cause it to change?

Students apply their understanding of the idea that wind and water can change the shape of the land to compare design solutions to slow or prevent such change.

What do plants need to grow?

Students investigate and use models to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination.

What are the different kinds of land and bodies of water?

Students use information and models to identify and represent the shapes and kinds of land and bodies of water in an area and where water is found on Earth.

How many types of living things live in a place?

Students make observations and compare the diversity of life in different habitats.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Second Grade

Through the second-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In second grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence	• Physical Science (PS1) • Life Science (LS2, LS4) • Earth and Space Science (ESS1, ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Systems and System Models • Energy and Matter • Structure and Function • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Matter and Its Interactions (PS1)		
2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. ***Clarification Statement:*** *Observations could include color, texture, hardness, and flexibility.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed. NRC Framework Link

Matter and its Interactions (PS1)

2

2-PS1-2. Analyze data obtained from tests to determine which materials have the best properties for an intended purpose.

Clarification Statement: *Examples of properties could include strength, flexibility, hardness, texture, and absorbency.*
State Assessment Boundary: *Assessment of quantitative measurements is limited to length.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Analyze data from tests of an object or tool to determine if it works as intended. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Different properties are suited to different purposes. NRC Framework Link	**Cause and Effect** Simple tests can be designed to gather evidence to support or refute student ideas about causes. NRC Framework Link

Matter and its Interactions (PS1)		
2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. ***Clarification Statement:*** *Examples of pieces could include manipulatives, or other assorted small objects.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Different properties are suited to different purposes. A great variety of objects can be built up from a small set of pieces. NRC Framework Link	**Energy and Matter** Objects may break into smaller pieces and be put together into larger pieces, or change shapes. NRC Framework Link

Matter and its Interactions (PS1)		
2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. ***Clarification Statement:*** *Examples of reversible changes could include materials such as water, crayons, or butter at different temperatures. Examples of irreversible changes could include cooking an egg, baking a cake, or preparing popcorn.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in K-2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). Construct an argument with evidence to support a claim. NRC Framework Link	**PS1.B: Chemical Reactions** Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
2-LS2-1. Plan and conduct an investigation to determine what plants need to grow. ***Clarification Statement:*** *Emphasis is on plants depending on water, light, or soil to grow.* ***State Assessment Boundary:*** *Assessment is limited to testing one variable at a time.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** Plants depend on air, water, minerals (in the soil), and light to grow. Different plants survive better in different settings because they have varied needs for water, minerals, and sunlight. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)

2

ETS1

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. Develop a simple model based on evidence to represent a proposed object or tool. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** Plants depend on animals for pollination or to move their seeds around. NRC Framework Link **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. NRC Framework Link	**Structure and Function** The shape and stability of structures of natural and designed objects are related to their function(s). NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
2-LS4-1. Make observations of plants and animals to compare patterns of diversity within different habitats. ***Clarification Statement:*** *Emphasis is on the diversity of living things in a variety of different habitats.* ***State Assessment Boundary:*** *Assessment does not include specific animal and plant names in specific habitats.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. Make observations (firsthand or from media) to collect data which can be used to make comparisons. NRC Framework Link	**LS4.D: Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and in water. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence NRC Framework Link

Earth’s Place in the Universe (ESS1)

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur rapidly or slowly.

Clarification Statement: *Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly or erosion of rocks, which occurs slowly.*
State Assessment Boundary: *Assessment does not include quantitative measurements of timescales.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Make observations from several sources to construct an evidence-based account for natural phenomena. NRC Framework Link	**ESS1.C: The History of Planet Earth** Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. NRC Framework Link	**Stability and Change** Things may change slowly or rapidly. NRC Framework Link

Earth's Systems (ESS2)

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

Clarification Statement: *Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, or different designs for using shrubs, grass, or trees to hold back the land.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Compare multiple solutions to a problem. NRC Framework Link	**ESS2.A: Earth Materials and Systems** Wind and water can change the shape of the land. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Developing and using technology has impacts on the natural world. *(secondary)* NRC Framework Link	**Stability and Change** Things may change slowly or rapidly. NRC Framework Link

Earth's Systems (ESS2)		
2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area. ***State Assessment Boundary:*** *Assessment does not include quantitative scaling in models.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in K-2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. Develop a model to represent patterns in the natural world. NRC Framework Link	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** Maps show where things are located. One can map the shapes and kinds of land and water in any area. NRC Framework Link	**Patterns** Patterns in the natural world can be observed. NRC Framework Link

Earth’s Systems (ESS2)

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in K-2 builds on prior experiences and uses observations and texts to communicate new information. Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. NRC Framework Link	**ESS2.C: The Roles of Water in Earth’s Surface Processes** Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. NRC Framework Link	**System and System Models** Objects and organisms can be described in terms of their parts. Systems in the natural and designed world have parts that work together. NRC Framework Link

Earth and Human Activity (ESS3)

2-ESS3-1. Design solutions to address human impacts on natural resources in the local environment.

State Assessment Boundary: *Assessment does not include energy resources such as coal or other fuels.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** Things that people do to live can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. NRC Framework Link **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. Thus, developing and using technology has impacts on the natural world. NRC Framework Link	**Cause and Effect** Events have causes that generate observable patterns. NRC Framework Link

Third Grade

South Carolina third-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The performance expectations in third grade help students engage in inquiry questions such as, **but not limited to:**

How do equal and unequal forces on an object affect the object? Students investigate the effects of balanced and unbalanced forces on the motion of an object and develop an understanding of the cause-and-effect relationships of electric and magnetic interactions between two objects not in contact with each other.	**What happens to organisms when their environment changes?** Students construct arguments from evidence to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die.
How can magnets be used? Students apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets.	**How can the impact of weather-related hazards be reduced?** Students make a claim about the effectiveness of a design solution that reduces the impacts of a weather-related hazard by applying their understanding of weather-related hazards.
How are plants, animals, and environments of the past similar or different from current plants, animals, and environments? Students analyze and interpret data to develop an understanding of types of organisms that lived long ago and also about the nature of their environments.	**What is typical weather in different parts of the world and during different times of the year?** Students organize and use data to describe typical weather conditions expected during a particular season. An exploration of weather patterns over time enables students to understand various climates found around the world.
How do organisms vary in their traits? Students develop and use models to build an understanding of the similarities and differences of organisms' life cycles. An understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops, is developed by students at this level. In addition, students construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.	

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Third Grade

Through the third-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In third grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Asking Questions and Defining Solutions • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS2) • Life Science (LS1, LS2, LS3, LS4) • Earth and Space Science (ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Motion and Stability: Forces and interactions (PS2)

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Clarification Statement: *Examples could include an unbalanced force on one side of a ball, which causes motion; and balanced forces pushing on a box from opposite sides, which does not cause motion.*
State Assessment Boundary: *Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. 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. NRC Framework Link	**PS2.A: Forces and Motion** Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. NRC Framework Link **PS2.B: Types of Interactions** Objects in contact exert forces on each other. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change. NRC Framework Link

Motion and Stability: Forces and interactions (PS2)		
3-PS2-2. **Make observations and measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.** ***Clarification Statement:*** *Examples of motion with a predictable pattern could include a pendulum swinging, a ball rolling back and forth in a bowl, and two children on a seesaw.* ***State Assessment Boundary:*** *Assessment does not include technical terms such as period and frequency.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. 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. NRC Framework Link	**PS2.A: Forces and Motion** The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. NRC Framework Link	**Patterns** Patterns of change can be used to make predictions. NRC Framework Link

Motion and Stability: Forces and interactions (PS2)

3-PS2-3. Ask questions to determine cause-and-effect relationships of electric interactions and magnetic interactions between two objects not in contact with each other.

Clarification Statement: *Examples could include the interactive force on hair from an electrically charged balloon or other instances of static electricity. Examples could include either the magnetic force between two permanent magnets or an electromagnet and steel paper clips. Examples of cause-and-effect relationships could include how the distance between objects affects strength of the force, how combining magnets affects the strength of the force, and how the orientation of magnets affects the direction of the force.*
State Assessment Boundary: *Assessment does not include electric interactions other than static electricity.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships. Ask questions that can be investigated based on patterns such as cause and effect relationships. NRC Framework Link	**PS2.B: Types of Interactions** Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change. NRC Framework Link

Motion and Stability: Forces and interactions (PS2)

3-PS2-4. Develop possible solutions to a simple design problem by applying scientific ideas about magnets.

Clarification Statement: *Examples could include latching a door to keep it shut or keeping objects apart, so they do not touch.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. NRC Framework Link	**PS2.B: Types of Interactions** Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. NRC Framework Link **ETS1.B: Developing Possible Solutions** Testing a solution involves investigating how well it performs under a range of likely conditions. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. NRC Framework Link	**Systems and System Models** A system can be described in terms of its components and their interactions NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)		
3-LS1-1. Develop and use models to describe how organisms change in predictable patterns during their unique and diverse life cycles. ***Clarification Statement:*** *Changes organisms go through during their life cycles could include birth/sprouting, growth, reproduction, and death.* ***State Assessment Boundary:*** *Assessment does not include human examples or details of reproduction beyond two ways animals are born: live from mother or hatched from eggs.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop models to describe phenomena. NRC Framework Link	**LS1.B: Growth and Development of Organisms** Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. NRC Framework Link	**Patterns** Patterns of change can be used to make predictions. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
3-LS2-1. Construct an argument that some animals form groups that help members survive.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model. NRC Framework Link	**LS2.D: Social Interactions and Group Behavior** Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. Groups can be collections of equal individuals, hierarchies with dominant members, small families, groups of single or mixed gender, or groups composed of individuals similar in age. Some groups are stable over long periods of time; others are fluid, with members moving in and out. Some groups assign specialized tasks to each member; in others, all members perform the same or a similar range of functions. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)

3

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have inherited traits that vary within a group of similar organisms.

Clarification Statement: *Similarities and differences in shared traits form patterns among parents, siblings, and offspring.*
State Assessment Boundary: *Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning. NRC Framework Link	**LS3.A: Inheritance of Traits** Many characteristics of organisms are inherited from their parents. NRC Framework Link **LS3.B: Variation of Traits** Different organisms vary in how they look and function because they have different inherited information. NRC Framework Link	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)		
3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment. ***Clarification Statement:*** *Examples could include stunted growth in plants due to insufficient resources or obesity in animals that eat too much and get little exercise.* ***State Assessment Boundary:*** *Assessment is limited to non-human examples.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., observations, patterns) to support an explanation. NRC Framework Link	**LS3.A: Inheritance of Traits** Some characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. NRC Framework Link **LS3.B: Variation of Traits** The environment affects the traits that an organism develops. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
3-LS4-1. Analyze and interpret data from fossils to provide evidence of organisms and the environments in which they lived long ago. ***Clarification Statement:*** *Examples could include marine fossils found on dry land and tropical plant fossils found in cold regions.* ***State Assessment Boundary:*** *Assessment does not include identification of specific fossils or fossils of organisms still in existence. Assessment is limited to major fossil types and relative ages.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning. NRC Framework Link	**LS4.A: Evidence of Common Ancestry and Diversity** Some kinds of plants and animals that once lived on Earth are no longer found anywhere. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. NRC Framework Link	**Scale, Proportion, and Quantity** Observable phenomena exist from very short to very long time periods. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
3-LS4-2. **Use evidence to construct an explanation for how the variations in traits among individuals of the same species may provide advantages in surviving and producing offspring.** ***Clarification Statement:*** *Examples could include plants that have larger thorns than other plants may be less likely to be eaten, or animals that have better camouflage may be more likely to survive and produce offspring.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., observations, patterns) to construct an explanation. NRC Framework Link	**LS4.B: Natural Selection** Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can thrive, struggle to survive, or fail to survive. ***Clarification Statement:*** *Examples could include needs and characteristics of the organisms and habitats involved. Changes in a habitat are sometimes beneficial, sometimes neutral, or sometimes harmful to an organism.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence. NRC Framework Link	**LS4.C: Adaptation** Adaptation can lead to organisms that are better suited for their environment. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)

3-LS4-4. Make a claim about the effectiveness of a solution to a problem caused when the environment changes and affects organisms living there.

Clarification Statement: *Examples could include changes within a system such as land characteristics, water distribution, temperature, food, and other organisms.*
State Assessment Boundary: *Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). 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. NRC Framework Link	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. *(secondary)* NRC Framework Link **LS4.D: Biodiversity and Humans** Populations live in a variety of habitats and change in those habitats affects the organisms living there. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. NRC Framework Link (continued on next page)	**Systems and System Models** A system can be described in terms of its components and their interactions. NRC Framework Link

	ETS2.A: Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering. NRC Framework Link	

Earth's Systems (ESS2)		
3-ESS2-1. Represent data in tables and graphical displays of typical weather conditions during a particular season to identify patterns and make predictions. ***Clarification Statement:*** *Examples could include making predictions about weather conditions based on average temperature, precipitation, and wind direction.* ***State Assessment Boundary:*** *Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. NRC Framework Link	**ESS2.D: Weather and Climate** Weather, which varies from day to day and seasonally throughout the year, is the condition of the atmosphere at a given place and time. Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. NRC Framework Link	**Patterns** Patterns of change can be used to make predictions. NRC Framework Link

Earth's Systems (ESS2)		
3-ESS2-2. Obtain and combine information to describe climate patterns in different regions of the world.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3-5 builds on K-2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and other reliable media to explain phenomena. NRC Framework Link	**ESS2.D: Weather and Climate** Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. NRC Framework Link	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. NRC Framework Link

Earth and Human Activity (ESS3)		
3-ESS3-1. Make a claim about the effectiveness of a design solution that reduces the impacts of a weather related hazard. ***Clarification Statement:*** *Examples of design solutions could include barriers to prevent flooding, wind resistant roofs, and lighting rods.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). 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. NRC Framework Link	**ESS3.B: Natural Hazards** A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change. NRC Framework Link

Fourth Grade

South Carolina fourth-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The performance expectations in fourth grade help students engage in inquiry questions such as, **but not limited to:**

What are waves and what are some things they can do?
Students use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move.

What is energy and how is it related to motion?
Students use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object.

What patterns of Earth's features can be determined with the use of maps?
Students analyze and interpret data from maps to describe patterns of Earth's features.

How can energy be used to solve a problem?
Students apply their understanding of energy to design, test, and refine a device that converts energy from one form to another.

How is energy transferred?
Students ask questions and make observations to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions.

How can water, ice, wind and vegetation change the land?
Students develop an understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans.

How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? Students develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Fourth Grade

Through the fourth-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In fourth grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS3, PS4) • Life Science (LS1) • Earth and Space Science (ESS1, ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Systems and System Models • Energy and Matter

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Energy (PS3)

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.

State Assessment Boundary: *Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence (e.g., measurements, observations, patterns) to construct an explanation. NRC Framework Link	**PS3.A: Definitions of Energy** The faster a given object is moving, the more energy it possesses. NRC Framework Link	**Energy and Matter** Energy can be transferred in various ways and between objects. NRC Framework Link

Energy (PS3)

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

State Assessment Boundary: *Assessment does not include quantitative measurements of energy or the difference between transferring and transforming energy.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. NRC Framework Link	**PS3.A: Definitions of Energy** Energy can be moved [transferred] from place to place by moving objects or through sound, light, or electric currents. NRC Framework Link **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Light also transfers energy from place to place. Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. NRC Framework Link	**Energy and Matter** Energy can be transferred in various ways and between objects. NRC Framework Link

Energy (PS3)

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.**

Clarification Statement: *Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.*
State Assessment Boundary: *Assessment does not include quantitative measures of changes in the speed of an object (acceleration) or quantitative measurements of energy.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3-5 builds on grades K-2 experiences and progresses to specifying qualitative relationships. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships. NRC Framework Link	**PS3.A: Definitions of Energy** Energy can be moved from place to place by moving objects or through sound, light, or electric currents. NRC Framework Link **PS3.B: Conservation of Energy and Energy Transfer** Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. NRC Framework Link **PS3.C: Relationship Between Energy and Forces** When objects collide, the contact forces transfer energy so as to change the objects' motions. NRC Framework Link	**Energy and Matter** Energy can be transferred in various ways and between objects. NRC Framework Link

4

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Clarification Statement: *Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, and time to design the device.*

State Assessment Boundary: *Devices should be limited to those that convert motion energy to electric energy or use stored energy (batteries) to cause motion or produce light or sound.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Apply scientific ideas to solve design problems. NRC Framework Link	**PS3.B: Conservation of Energy and Energy Transfer** Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. NRC Framework Link **PS3.D: Energy in Chemical Processes and Everyday Life** The expression “produce energy” typically refers to the conversion of stored energy into a desired form for practical use. NRC Framework Link **ETS1.A: Defining and Delimiting an Engineering Problem** Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). (Continued Next Page)	**Energy and Matter** Energy can be transferred in various ways and between objects. NRC Framework Link

	ETS1.A: Defining and Delimiting an Engineering Problem (Cont.) Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. NRC Framework Link **ETS1.B: Developing Possible Solution** At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones. *(secondary)* NRC Framework Link	

Waves and their Applications in Technologies for Information Transfer (PS4)

4

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.

Clarification Statement: *Examples of models include diagrams, analogies, or physical models using (but not limited to) stringed beads, rubber bands, wire, or yarn to illustrate amplitude of waves and wavelength.*
State Assessment Boundary: *Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model using an analogy, example, or abstract representation to describe a scientific principle. NRC Framework Link	**PS4.A: Wave Properties** Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). NRC Framework Link	**Patterns** Similarities and differences in patterns can be used to sort and classify natural phenomena. NRC Framework Link

Waves and their Applications in Technologies for Information Transfer (PS4)		
4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. ***State Assessment Boundary:*** *Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. NRC Framework Link	**PS4.B: Electromagnetic Radiation** An object can be seen when light reflected from its surface enters the eyes. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified. NRC Framework Link

Waves and their Applications in Technologies for Information Transfer (PS4)

4-PS4-3. Generate and compare multiple solutions that use patterns to transmit information.

Clarification Statement: *Examples of solutions include drums sending coded information through sound waves, using a grid of 0s and 1s representing black and white to send information about a picture, QR codes, barcodes, and using Morse code to send text. The coding method does not need to be electronic or digital, and the code should only be two possible values such as on/off, 0/1, black/white.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. NRC Framework Link	**PS4.C: Information Technologies and Instrumentation** Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. When in digitized form, information can be recorded, stored for future recovery, and transmitted over long distances without significant degradation of the wave. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Different solutions need to be tested in order to determine which of the best solves the problem, given the criteria and the constraints. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Knowledge of relevant scientific concepts and research findings is important in engineering. NRC Framework Link	**Patterns** Similarities and differences in patterns can be used to sort and classify designed products. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function together in a system to support survival, growth, behavior, and reproduction.

Clarification Statement: *Examples of structures could include thorns, roots, heart, lungs, or skin.*
State Assessment Boundary: *Assessment does not include microscopic structures within plant and animal systems.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence, data, and/or a model. NRC Framework Link	**LS1.A: Structure and Function** Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. NRC Framework Link	**Systems and System Models** A system can be described in terms of its components and their interactions. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1) 4		
4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. ***Clarification Statement:*** *Emphasis is on systems of information transfer.* ***State Assessment Boundary:*** *Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use a model to test interactions concerning the functioning of a natural system. NRC Framework Link	**LS1.D: Information Processing** Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. NRC Framework Link	**Systems and System Models** A system can be described in terms of its components and their interactions. NRC Framework Link

Earth's Place in the Universe (ESS1)		
4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. ***Clarification Statement:*** *Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.* ***State Assessment Boundary:*** *Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Identify the evidence that supports particular points in an explanation. NRC Framework Link	**ESS1.C: The History of Planet Earth** Local, regional, and global patterns of rock formations reveal changes over time due to Earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. NRC Framework Link	**Patterns** Patterns can be used as evidence to support an explanation. NRC Framework Link

Earth's Systems (ESS2)

4

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Clarification Statement: *Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.*
State Assessment Boundary: *Assessment is limited to a single form of weathering or erosion.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. NRC Framework Link	**ESS2.A: Earth Materials and Systems** Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. NRC Framework Link **ESS2.E: Biogeology** Living things affect the physical characteristics of their regions. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change. NRC Framework Link

Earth's Systems (ESS2)		
4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. ***Clarification Statement:*** *Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, or earthquakes.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning. NRC Framework Link	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. NRC Framework Link	**Patterns** Patterns can be used as evidence to support an explanation. NRC Framework Link

Earth and Human Activity (ESS3)

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and how their uses affect the environment.

Clarification Statement: *Examples of renewable resources could include wind energy, water behind dams, and sunlight; non-renewable resources are fossil and nuclear fuels.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3-5 builds on K-2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. Obtain and combine information from books and other reliable media to explain phenomena. NRC Framework Link	**ESS3.A: Natural Resources** All materials, energy, and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Knowledge of relevant scientific concepts and research findings is important in engineering. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Over time, people's needs and wants change, as do their demands for new and improved technologies. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change. NRC Framework Link

Earth and Human Activity (ESS3)

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Clarification Statement: *Examples of solutions could include designing earthquake or hurricane resistant buildings, improving the monitoring of tornadic or volcanic activity, and constructing waterways for floodwaters.*
State Assessment Boundary: *Assessment is limited to earthquakes, floods, hurricanes, tornadoes, and coastal erosion.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3-5 builds on K-2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. Use evidence in creating multiple solutions to design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. NRC Framework Link	**ESS3.B Natural Hazards** A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. NRC Framework Link **ETS1.B: Developing Possible Solutions** Testing a solution involves investigating how well it performs under a range of likely conditions. Communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change. NRC Framework Link

Fifth Grade

South Carolina fifth-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The performance expectations in fifth grade help students engage in inquiry questions such as, **but not limited to:**

When matter changes, does its weight change?
Students describe that matter is made of particles too small to be seen through the development of a model. Students also measure and graph quantities to develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved.

How much water can be found in different places on Earth?
Students describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact through the development of a model. They describe and graph data to provide evidence about the distribution of water on Earth.

How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?
Students support an argument with evidence and represent data in graphical displays to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

How does matter cycle through ecosystems and where does the energy in food come from and what is it used for?
Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals' food was once energy from the sun.

Can new substances be created by combining other substances?
Students make observations and measurements to determine whether the mixing of two or more substances results in new substances.

How can we protect the Earth's resources and environment?
Students evaluate solutions for local communities to protect the Earth's resources and environment.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Fifth Grade

Through the fifth-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In fifth grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS1, PS2, PS3) • Life Science (LS1, LS2) • Earth and Space Science (ESS1, ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Matter and Its Interactions (PS1)

5

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.

Clarification Statement: *Examples of evidence supporting a model could include adding air to expand a basketball, dissolving and evaporating salt water, and effects of air particles on larger objects such as leaves.*
State Assessment Boundary: *Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Matter of any type can be subdivided into particles that are too small to see, but even then, the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space (and can be detected by their impact on other objects) can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. NRC Framework Link	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large. NRC Framework Link

Matter and Its Interactions (PS1)

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.

Clarification Statement: *Examples of reactions or changes could include phase changes over time, dissolving, mixing that form new substance, and weighing substances before and after changes.*
State Assessment Boundary: *Assessment does not include distinguishing mass and weight.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 3-5 builds on K-2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Measure and graph quantities such as weight to address scientific and engineering questions and problems. NRC Framework Link	**PS1.A: Structure and Properties of Matter** The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. NRC Framework Link **PS1.B: Chemical Reactions** No matter what reaction or change in properties occurs, the total weight of the substances does not change. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Tools and instruments (e.g., scales, thermometers, graduated cylinders) are used in scientific exploration to gather data and help answer questions about the natural world. NRC Framework Link	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. NRC Framework Link

Matter and Its Interactions (PS1)

5-PS1-3. Make observations and measurements to identify materials based on their properties.

Clarification Statement: *Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, and reflectivity; density is not intended as an identifiable property.*
State Assessment Boundary: *Assessment does not include density or distinguishing mass and weight.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Measurements of a variety of properties can be used to identify materials. At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation. NRC Framework Link ETS2 **ETS2.A: Interdependence of Science, Engineering, and Technology** Tools and instruments (e.g., scales, thermometers, graduated cylinders) are used in scientific exploration to gather data and help answer questions about the natural world. NRC Framework Link	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. NRC Framework Link

Matter and Its Interactions (PS1)

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

State Assessment Boundary: *Mass and weight are not distinguished.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 builds on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. 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. NRC Framework Link	**PS1.B: Chemical Reactions** When two or more different substances are mixed, a new substance with different properties may be formed. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified, tested, and used to explain change. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)		
5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down. ***Clarification Statement:*** *"Down" is a local description of the direction that points toward the center of the spherical Earth.* ***State Assessment Boundary:*** *Assessment does not include mathematical representation of gravitational force.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model. NRC Framework Link	**PS2.B: Types of Interactions** The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships are routinely identified and used to explain change. NRC Framework Link

Energy (PS3)		
5-PS3-1. **Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** ***Clarification Statement:*** *Examples of models could include food webs or diagrams and flowcharts to illustrate the flow of energy.* ***State Assessment Boundary:*** *Assessment does not include cellular mechanisms of digestive absorption.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Use models to describe phenomena. NRC Framework Link	**PS3.D: Energy in Chemical Processes and Everyday Life** The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). NRC Framework Link **LS1.C: Organization for Matter and Energy Flow in Organisms** Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. *(secondary)* NRC Framework Link	**Energy and Matter** Energy can be transferred in various ways and between objects. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)		
5-LS1-1. Support an argument with evidence that plants obtain materials they need for growth mainly from air and water. ***Clarification Statement:*** *Without inputs of energy (sunlight) and matter (carbon dioxide and water), a plant cannot grow. Evidence could be drawn from diagrams, models, and data that are gathered from investigations.* ***State Assessment Boundary:*** *Assessment does not include molecular explanations of photosynthesis.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** Plants acquire their material for growth chiefly from air and water. NRC Framework Link	**Energy and Matter** Matter is transported into, out of, and within systems. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		5
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. ***Clarification Statement:*** *Emphasis is on the idea that matter that is not food (such as air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.* ***State Assessment Boundary:*** *Assessment does not include molecular explanations.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3-5 builds on K-2 models and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model to describe phenomena. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** The food of almost any kind of animal can be traced back to plants (producers). Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants (either way they are consumers). Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. NRC Framework Link (continued on next page)	**Systems and System Models** A system can be described in terms of its components and their interactions. NRC Framework Link

	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. NRC Framework Link	

Earth's Place in the Universe (ESS1)		
5-ESS1-1. Support an argument with evidence that the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. ***Clarification Statement:*** *Evidence could be drawn from various media, diagrams, models, or data that are gathered from investigations.* ***State Assessment Boundary:*** *Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness such as stellar masses, age, and stage.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3-5 builds on K-2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Support an argument with evidence, data, or a model. NRC Framework Link	**ESS1.A: The Universe and Its Stars** The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. NRC Framework Link	**Scale, Proportion, and Quantity** Natural objects exist from the very small to the immensely large. NRC Framework Link

Earth's Place in the Universe (ESS1)

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Clarification Statement: *Patterns could be revealed from graphical interpretations, various media, diagrams, models, or graphs constructed from data gathered from investigations. Examples of patterns could include the position and motion of Earth with respect to the sun or selected stars that are visible only in particular months.*
State Assessment Boundary: *Assessment does not include causes of seasons or labeling specific phases of the moon.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 3-5 builds on K-2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. NRC Framework Link	**ESS1.B: Earth and the Solar System** The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. NRC Framework Link	**Patterns** Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena. NRC Framework Link

Earth's Systems (ESS2)

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Clarification Statement: *Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.*
State Assessment Boundary: *Assessment is limited to the interactions of two systems at a time.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. Develop a model using an example to describe a scientific principle. NRC Framework Link	**ESS2.A: Earth Materials and Systems** Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. NRC Framework Link	**Systems and System Models** A system can be described in terms of its components and their interactions. NRC Framework Link

Earth's Systems (ESS2)		
5-ESS2-2. Describe and graph the amounts of saltwater and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. ***State Assessment Boundary:*** *Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking in 3-5 builds on K-2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. Describe and graph quantities such as area and volume to address scientific questions. NRC Framework Link	**ESS2.C: The Roles of Water in Earth's Surface Processes** Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. NRC Framework Link	**Scale, Proportion, and Quantity** Standard units are used to measure and describe physical quantities such as weight and volume. NRC Framework Link

Earth and Human Activity (ESS3)		
5-ESS3-1. Evaluate potential solutions to problems that individual communities face in protecting the Earth's resources and environment.		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3-5 builds on K-2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. NRC Framework Link **ETS1.B: Developing Possible Solutions** Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. NRC Framework Link	**Systems and System Models** A system can be described in terms of its components and their interactions. NRC Framework Link

Sixth Grade

South Carolina sixth-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in sixth grade help students engage in inquiry questions such as, **but not limited to:**

What factors interact and influence weather and climate? Students use models and explore with evidence factors that control weather and climate.	**How do waves behave?** Students describe how mechanical and light waves behave when interacting with matter.
How do cells contribute to the function of living organisms and the organism's response to its environment? Students investigate that all organisms are made of cell(s), describe that special cells or structures are responsible for particular functions in organisms, and explain with evidence that for many organisms the body is a system of multiple interacting subsystems that form a hierarchy from cells to the body. Students synthesize information that sensory receptors respond to stimuli for behaviors or memory storage.	**How can a substance be changed by energy and how can energy be transferred from one object or system to another?** Students predict and investigate the relationship between energy (kinetic energy of moving objects) and temperature (average kinetic energy of particles in matter). Students also apply the engineering design process to develop a device that controls energy transfer.
How do the materials in and on Earth's crust change over time? Students describe how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students investigate the properties of important materials and construct explanations based on the analysis of real geoscience data.	**How do we know that the Earth and life on Earth have changed through time?** Students construct explanations based on geoscience data (locations and prevalence of specific rock types, fossils, continental features, ocean floor features, and earthquake events) to support that Earth and life on Earth has changed over time.
How do natural hazards and technologies impact Earth's systems and people? Students analyze and interpret natural hazards data for patterns to predict and reduce their impact on humans through use and development of new technologies.	

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Sixth Grade

Through the sixth-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In sixth grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS1, PS3, PS4) • Life Science (LS1) • Earth and Space Science (ESS1, ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter • Structure and function

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Matter and Its Interactions (PS1)

6-PS1-4. Develop and use a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

Clarification Statement: *Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.*
State Assessment Boundary: *The use of mathematical formulas is not required.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. NRC Framework Link (continued on next page)	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

	PS3.A: Definitions of Energy The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning, it refers to the energy transferred due to the temperature difference between two objects. (*secondary*) The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. (*secondary*) Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. (*secondary*) NRC Framework Link	

Energy (PS3)

6-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Clarification Statement: *Examples of devices could include an insulated box, a solar cooker, and a polystyrene foam cup.*
State Assessment Boundary: *Assessment does not include calculating the total amount of thermal energy transferred.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. NRC Framework Link	**PS3.A: Definitions of Energy** The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and energy transfers by convection, conduction, and radiation (particularly infrared and light). NRC Framework Link **PS3.B: Conservation of Energy and Energy Transfer** The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. Energy is spontaneously transferred out of hotter regions or objects and into colder ones by the processes of conduction, convection, and radiation. NRC Framework Link (continued on next page)	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. NRC Framework Link

	ETS1.A: Defining and Delimiting an Engineering Problem The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. NRC Framework Link **ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. NRC Framework Link	

Energy (PS3)		
6-PS3-4. **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.** ***Clarification Statement:*** *Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.* ***State Assessment Boundary:*** *Assessment does not include calculating the total amount of thermal energy transferred.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. NRC Framework Link	**PS3.A: Definitions of Energy** Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. NRC Framework Link **PS3.B: Conservation of Energy and Energy Transfer** The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. NRC Framework Link	**Scale, Proportion, and Quantity** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. NRC Framework Link

6-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Clarification Statement: *Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.*
State Assessment Boundary: *Assessment is limited to qualitative applications pertaining to light and mechanical waves.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**PS4.A: Wave Properties** A sound wave needs a medium through which it is transmitted. NRC Framework Link **PS4.B: Electromagnetic Radiation** When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves. NRC Framework Link	**Structure and Function** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Clarification Statement: *Emphasis is on developing evidence that living things are made of at least one cell, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.*
State Assessment Boundary: *Assessment does not include identification of specific cell types and should emphasize the use of evidence from investigations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. NRC Framework Link	**LS1.A: Structure and Function** All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). NRC Framework Link ETS2 **ETS2.A: Interdependence of Science, Engineering, and Technology** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. NRC Framework Link	**Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6

6-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function.

Clarification Statement: *Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.*
State Assessment Boundary: *Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**LS1.A: Structure and Function** Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. NRC Framework Link	**Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1) 6		
6-LS1-3. **Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.** ***Clarification Statement:*** *Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.* ***State Assessment Boundary:*** *Assessment does not include the mechanism of one body system independent of others or individual organs and structures. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, skeletal, and nervous systems and is limited to the interdependence of the body systems.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. NRC Framework Link	**LS1.A: Structure and Function** In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. NRC Framework Link	**Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

6

6-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Clarification Statement: *Examples of stimulus and sensory receptor pairings include electromagnetic stimuli (light intensity and color) are received by the eye; mechanical stimuli (sound waves) are received by the hair cells of the inner ear; mechanical stimuli (pressure) are received by the skin; and chemical stimuli (foods) are received by the various taste buds.*
State Assessment Boundary: *Assessment does not include identifying specific structures of the brain or mechanisms for the transmission of this information.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. NRC Framework Link	**LS1.D: Information Processing** Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. Changes in the structure and functioning of many millions of interconnected nerve cells allow combined inputs to be stored as memories for long periods of time. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural systems. NRC Framework Link

Earth's Place in the Universe (ESS1)		
6-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. ***Clarification Statement:*** *Emphasis is on analyses of rock formations and the fossils they contain to establish relative ages of major events in Earth's history. Scientific explanations can include models to study the geologic time scale.* ***State Assessment Boundary:*** *Assessment does not include recalling the names of specific periods or epochs and events within them.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS1.C: The History of Planet Earth** The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. Major historical events include the formation of mountain chains and ocean basins, the adaptation and extinction of particular living organisms, volcanic eruptions, periods of massive glaciation, and development of watersheds and rivers through glaciation and water erosion. NRC Framework Link	**Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. NRC Framework Link

Earth's Systems (ESS2)		
6-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. ***Clarification Statement:*** *Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.* ***State Assessment Boundary:*** *Assessment does not include the identification and naming of minerals.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**ESS2.A: Earth Materials and Systems** All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. NRC Framework Link	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion/and or cycling of matter. NRC Framework Link

Earth's Systems (ESS2)

6-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

Clarification Statement: *Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually, but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.*
State Assessment Boundary: *Assessment does not include identification or naming of specific events.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS2.A: Earth Materials and Systems** The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. NRC Framework Link **ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. NRC Framework Link	**Scale Proportion and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. NRC Framework Link

Earth's Systems (ESS2)

6-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.

Clarification Statement: *Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), the locations of ocean structures (such as ridges, fracture zones, and trenches), and the prevalence of earthquakes and volcanoes along plate boundaries.*
State Assessment Boundary: *Paleomagnetic anomalies in oceanic and continental crust are not assessed.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. NRC Framework Link	**ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geological history. Plate movements are responsible for most continental and ocean floor features and for the distribution of most rocks and minerals within Earth's crust. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. NRC Framework Link (continued on next page)	**Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems. NRC Framework Link

	ETS2.A: Interdependence of Science, Engineering, and Technology Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. NRC Framework Link	

Earth's Systems (ESS2)		
6-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. ***Clarification Statement:*** *Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.* ***State Assessment Boundary:*** *Assessment does not include a quantitative understanding of the latent heats of vaporization and fusion.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. NRC Framework Link	**ESS2.C: The Roles of Water in Earth's Surface Processes** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity. NRC Framework Link	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. NRC Framework Link

Earth's Systems (ESS2)

6

6-ESS2-5. Analyze and interpret data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.

Clarification Statement: *Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).*

State Assessment Boundary: *Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. NRC Framework Link	**ESS2.C: The Roles of Water in Earth's Surface Processes** The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. NRC Framework Link **ESS2.D: Weather and Climate** Because these patterns are so complex, weather can only be predicted probabilistically. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Earth's Systems (ESS2)

6-ESS2-6. Develop and use models to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

Clarification Statement: *Emphasis is on patterns of global and regional climate that vary due to atmospheric circulation, oceanic circulation, and geographic land features.*
State Assessment Boundary: *Assessment does not include the dynamics of the Coriolis Effect, thermohaline circulation, or the role of density.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**ESS2.C: The Roles of Water in Earth's Surface Processes** Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. NRC Framework Link **ESS2.D: Weather and Climate** The tilt of the earth's rotational axis causes a pattern of uneven heating and cooling that changes seasonally and establishes global patterns of climate and weather. Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. NRC Framework Link	**Systems and System Models** Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems. NRC Framework Link

Earth and Human Activity (ESS3)

6

6-ESS3-2. Analyze and interpret data on natural hazards to identify patterns, which help forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Clarification Statement: *Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado- prone regions or reservoirs to mitigate droughts).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. NRC Framework Link	**ESS3.B: Natural Hazards** Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. NRC Framework Link ETS2 **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. NRC Framework Link	**Patterns** Graphs, charts, and images can be used to identify patterns in data. NRC Framework Link

Seventh Grade

South Carolina seventh-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in seventh grade help students engage in inquiry questions such as, **but not limited to:**

How do atomic and molecular interactions explain the properties of matter that we see and feel? Students develop models to describe atomic composition of simple molecules and complex extended molecules.	**How are synthetic materials made from natural resources important to people?** Students use information to make sense of and evaluate how synthetic materials are made from natural resources and how society has been influenced by these materials.
How do mass, speed and position affect kinetic and potential energy of objects, and how is energy transferred from one object to another? Students use evidence to support a claim that energy is transferred between objects, and that the relationship of mass and speed on kinetic energy, and position on potential energy of objects interact in a system.	**How do organisms interact with other organisms in the physical environment to obtain matter and energy?** Students analyze and interpret data as evidence that organisms and populations of organisms are dependent on their environmental resources, explain patterns of interactions with other organisms, and describe cycling of matter and energy flow in an ecosystem.
How does matter and energy move through an ecosystem? Students explain with evidence how matter and energy cycle in an ecosystem and describe the interaction of organisms to obtain food to survive and grow.	**How is the health of an ecosystem determined?** Students construct an argument and evaluate solutions of how biodiversity, ecosystem services and environmental changes can impact the integrity of an ecosystem.
How does surface processes and human activity affect Earth temperature and systems? Students ask questions, apply scientific principles, and explain how human use and of Earth's resources due to geoscience processes have impacted global temperatures and systems.	

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Seventh Grade

Through the seventh-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In seventh grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS1, PS3) • Life Science (LS1, LS2, LS4) • Earth and Space Science (ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter • Structure and Function • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Matter and Its Interactions (PS1)

7-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.

Clarification Statement: *Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended atomic structures will assist students in making sense of different phenomena such as how diamonds and graphite can both be made of pure carbon. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.*
State Assessment Boundary: *Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to predict and/or describe phenomena. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). NRC Framework Link	**Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. NRC Framework Link

Matter and Its Interactions (PS1)		
7-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. ***Clarification Statement:*** *Examples of reactions could include burning sugar or steel wool, milk curdling, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.* ***State Assessment Boundary:*** *Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. NRC Framework Link **PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. NRC Framework Link	**Patterns** Macroscopic patterns are related to the nature of microscopic and atomic-level structure. NRC Framework Link

Matter and Its Interactions (PS1)

7

7-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Clarification Statement: *Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, plastic made from petroleum, and alternative fuels.*
State Assessment Boundary: *Assessment is limited to qualitative data.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. NRC Framework Link **PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. NRC Framework Link ETS2 **ETS2.A: Interdependence of Science, Engineering, and Technology** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. NRC Framework Link (continued on next page)	**Structure and Function** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. NRC Framework Link	

Matter and Its Interactions (PS1)

7-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Clarification Statement: *Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms.*

State Assessment Boundary: *Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. NRC Framework Link	**PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each atom is conserved, and thus the mass does not change. Some chemical reactions release energy, others store energy. NRC Framework Link	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes. NRC Framework Link

Matter and Its Interactions (PS1)

7

ETS1

7-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

Clarification Statement: *Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride, combining baking soda and vinegar, or combining sodium bicarbonate tablets and water.*
State Assessment Boundary: *Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. NRC Framework Link	**PS1.B: Chemical Reactions** Some chemical reactions release energy, others store energy. NRC Framework Link **ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. NRC Framework Link	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. NRC Framework Link

Energy (PS3)

7

7-PS3-1. Construct and interpret graphical displays of data to describe the proportional relationships of kinetic energy to the mass of an object and to the speed of an object.

Clarification Statement: *Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and being hit by a wiffle ball versus a tennis ball.*
State Assessment Boundary: *Assessment does not include mathematical calculations of kinetic energy.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Construct and interpret graphical displays of data to identify linear and nonlinear relationships. NRC Framework Link	**PS3.A: Definitions of Energy** Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. NRC Framework Link	**Scale, Proportion, and Quantity** Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. NRC Framework Link

Energy (PS3)

7

7-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

Clarification Statement: *Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.*
State Assessment Boundary: *Assessment is limited to two objects and electric, magnetic, and gravitational interactions.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. NRC Framework Link	**PS3.A: Definitions of Energy** A system of objects may also contain stored (potential) energy, depending on their relative positions. NRC Framework Link **PS3.C: Relationship Between Energy and Forces** When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. NRC Framework Link	**Systems and System Models** Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. NRC Framework Link

Energy (PS3)

7

7-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Clarification Statement: *Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of the object.*
State Assessment Boundary: *Assessment does not include calculations of energy.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. NRC Framework Link	**PS3.B: Conservation of Energy and Energy Transfer** When the motion energy of an object changes, there is inevitably some other change in energy at the same time. NRC Framework Link	**Energy and Matter** Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

7-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

Clarification Statement: *Emphasis is on tracing movement of matter and flow of energy.*
State Assessment Boundary: *Assessment does not include biochemical mechanisms of photosynthesis.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. In most animals and plants, oxygen reacts with carbon- containing molecules (sugars) to provide energy and produce carbon dioxide; anaerobic bacteria achieve their energy needs in other chemical processes that do not require oxygen. NRC Framework Link (continued on next page)	**Energy and Matter** Within a natural system, the transfer of energy drives the motion and/or cycling of matter. NRC Framework Link

	PS3.D: Energy in Chemical Processes and Everyday Life The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (*secondary*). NRC Framework Link	

From Molecules to Organisms: Structures and Processes (LS1)

7-LS1-7. Develop a model to describe how food molecules in plants and animals are rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

Clarification Statement: *Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.*
State Assessment Boundary: *Assessment does not include details of the chemical reactions for photosynthesis or respiration.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe unobservable mechanisms. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. NRC Framework Link **PS3.D: Energy in Chemical Processes and Everyday Life** Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. *(secondary)* NRC Framework Link	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
7-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. ***Clarification Statement:*** *Emphasis is on cause-and-effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.* ***State Assessment Boundary:*** *Assessment does not include determining the carrying capacity of ecosystems.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to provide evidence for phenomena. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. Growth of organisms and population increases are limited by access to resources. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
7-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. ***Clarification Statement:*** *Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. NRC Framework Link	**Patterns** Patterns can be used to identify cause-and-effect relationships. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
7-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. ***Clarification Statement:*** *Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.* ***State Assessment Boundary:*** *Assessment does not include the use of chemical reactions to describe the processes.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop a model to describe phenomena. NRC Framework Link	**LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. NRC Framework Link	**Energy and Matter** The transfer of energy can be tracked as energy flows through a natural system. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
7-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. ***Clarification Statement:*** *Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems. Disruptions to any physical or biological component of an ecosystem can lead to shifts in its populations.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. NRC Framework Link	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. NRC Framework Link	**Stability and Change** Small changes in one part of a system might cause large changes in another part. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)

7

ETS 1

7-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Clarification Statement: *Humans can benefit from services that are provided by healthy ecosystems. These ecosystem services could include climate stabilization, water purification, nutrient recycling, pollination, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. NRC Framework Link	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. NRC Framework Link **LS4.D: Biodiversity and Humans** Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. *(secondary)* NRC Framework Link **ETS1.B: Developing Possible Solutions** There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. NRC Framework Link (continued on next page)	**Stability and Change** Small changes in one part of a system might cause large changes in another part. NRC Framework Link

	ETS2.B: Influence of Science, Engineering, and Technology on Society and the Natural World The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. NRC Framework Link	

Earth and Human Activity (ESS3)

7-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.

Clarification Statement: *Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS3.A: Natural Resources** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. NRC Framework Link ETS2 **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Earth and Human Activity (ESS3)

7

7-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Clarification Statement: *Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles to design an object, tool, process or system. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** Human activities have significantly altered the biosphere, sometimes damaging, or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (continued on next page)	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World (Cont.) The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. NRC Framework Link	

Earth and Human Activity (ESS3)

7-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Clarification Statement: *Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Earth and Human Activity (ESS3)

7-ESS3-5. Ask questions to clarify evidence of the factors that have impacted global temperatures over the past century.

Clarification Statement: *Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6-8 builds on grades K-5 experiences and progresses to specifying relationships between variables and clarifying arguments and models. Ask questions to identify and clarify evidence of an argument. NRC Framework Link	**ESS3.D: Global Climate Change** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature. Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (continued on next page)	**Stability and Change** Stability might be disturbed either by sudden events or gradual changes that accumulate over time. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time. NRC Framework Link	

Eighth Grade

South Carolina eighth-grade students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in eighth grade help students engage in inquiry questions such as, **but not limited to:**

How can one describe physical interactions between objects and within systems of objects? Students apply Newton's third law of motion to related forces to explain the motion of objects colliding. Students also construct arguments, and analyze and interpret data on gravitational, electrical, and magnetic forces to explain a variety of phenomena including ideas about why some materials attract each other while others repel. Students investigate and evaluate evidence that objects exert force even without contact.	**How has life changed throughout Earth's history?** Students analyze and interpret data for patterns in how the fossil record documents Earth's history with existence, diversity, extinction and changing of life forms as well as construct an explanation for similarities and differences in modern day and ancestral organisms.
What are the characteristic properties of waves and how can they be used? Students describe characteristic properties of a wave and the behavior related to energy. Students communicate evidence that digital devices use waves to transmit information.	**How do organisms grow, develop, and reproduce?** Students explain based on evidence and reasoning how genetic factors, the environment, and an organism's behaviors and structures influence its growth, development, and reproduction.
How do changes to genes affect an organism? Students describe how genetic changes can affect the structure and function of an organism.	**How does the energy of an object change related to its mass, speed, and position in a system?** Students investigate for evidence that an object's motion depends on mass and sum of forces.
How does genetic variation among organisms in a species affect survival and reproduction? How does the environment and humans influence genetic traits in populations over multiple generations? Students use information and begin constructing an explanation of genetic variation in natural selection and how this leads to traits in a population changing.	**What is Earth's place in the Universe? What makes up our solar system and how can the motion of Earth explain seasons and eclipses?** Students describe Earth's place in relation to the solar system, Milky Way galaxy and universe, and evaluate information on scale properties of objects.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Eighth Grade

Through the eighth-grade performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In eighth grade, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS2, PS4) • Life Science (LS1, LS3, LS4) • Earth and Space Science (ESS1, ESS2) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Structure and Function • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Motion and Stability: Forces and Interactions (PS2)

8-PS2-1. Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects.

Clarification Statement: *Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.*
State Assessment Boundary: *Assessment is limited to vertical or horizontal interactions in one dimension.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas, principles, to design an object, tool, process, or system. NRC Framework Link	**PS2.A: Forces and Motion** For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). NRC Framework Link **ETS1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. NRC Framework Link (continued on next page)	**Systems and System Models** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. *(secondary)* NRC Framework Link	

Motion and Stability: Forces and Interactions (PS2)		
8-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. ***Clarification Statement:*** *Emphasis is on balanced (Newton's first law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's second law), frame of reference, and specification of units.* ***State Assessment Boundary:*** *Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many examples of data are needed to support a claim. NRC Framework Link	**PS2.A: Forces and Motion** The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change (inertia). The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. The positions of objects and the directions of forces and motions must be described using a qualitative comparison and scalar quantities. In order to share information with other people, a reference frame must also be shared. NRC Framework Link	**Stability and Change** Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)

8-PS2-3. Analyze and interpret data to determine the factors that affect the strength of electric and magnetic forces.

Clarification Statement: *Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.*
State Assessment Boundary: *Assessment is limited to data examples using proportional reasoning and algebraic thinking, rather than mathematical computations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze displays of data to identify linear and nonlinear relationships. NRC Framework Link	**PS2.B: Types of Interactions** Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)

8-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects and the distance between them.

Clarification Statement: *Examples of evidence for arguments could include data generated from simulations or digital tools, and charts displaying mass, strength of interaction, distance between objects, and orbital periods of objects within the solar system.*
State Assessment Boundary: *Assessment does not include Newton's law of gravitation or Kepler's laws.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds from K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. NRC Framework Link	**PS2.B: Types of Interactions** The magnitude of the gravitational force depends on the masses and distances between interacting objects. Long-range gravitational interactions govern the evolution and maintenance of large-scale structures in the universe and the patterns of motion within them. NRC Framework Link	**Systems and System Models** Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)		
8-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. ***Clarification Statement****: Examples of this phenomenon could include the interactions of magnets and electrically charged objects. Examples of investigations could include first-hand experiences or simulations.* ***State Assessment Boundary:*** *Assessment is limited to electric and magnetic fields and limited to qualitative evidence for the existence of fields.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. NRC Framework Link	**PS2.B: Types of Interactions** Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be illustrated by their effect on a test object (a charged object, or a ball, respectively). NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural or designed systems. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)		
8-PS4-1. Using mathematical representations, describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. ***Clarification Statement:*** *Emphasis is on describing waves with both qualitative and quantitative thinking.* ***State Assessment Boundary:*** *Assessment does not include electromagnetic waves and is limited to standard repeating waves. Assessment does not include relationships between the speed of waves and their frequency or wavelength.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking at the 6-8 level builds on K-5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to describe and/or support scientific conclusions and design solutions. NRC Framework Link	**PS4.A: Wave Properties** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. NRC Framework Link	**Patterns** Graphs and charts can be used to identify patterns in data. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4) 8		
8-PS4-3. Communicate information to support the claim that digital devices are used to improve our understanding of how waves transmit information. ***Clarification Statement:*** *Emphasis is on a basic understanding that waves can be used for communication purposes and digitized signals are a more reliable way to encode and transmit information than analog. When in digitized form, information can be recorded, stored for future recovery, and transmitted over long distances without significant degradation. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversion of stored binary patterns to make sound or text on a computer screen.* ***State Assessment Boundary:*** *Assessment does not include binary counting nor the specific mechanism of any given device.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. Integrate qualitative scientific and technical information in different forms of text that are contained in media and visual displays to clarify claims and findings. NRC Framework Link	**PS4.C: Information Technologies and Instrumentation** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. NRC Framework Link ETS2 **ETS2.B: Influence of Science, Engineering, and Technology on Society and the Natural World** Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. NRC Framework Link	**Structure and Function** Structures can be designed to serve particular functions. NRC Framework Link

8

8-LS1-4. Use arguments, based on empirical evidence and scientific reasoning, to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Clarification Statement: *Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 6-8 builds on K-5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. NRC Framework Link	**LS1.B: Growth and Development of Organisms** Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. NRC Framework Link	**Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

8

8-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Clarification Statement: *Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include how drought or flooding affects plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.*
State Assessment Boundary: *Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories. Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS1.B: Growth and Development of Organisms** Genetic factors as well as local conditions affect the growth of the adult plant. The growth of an animal is controlled by genetic factors, food intake, and interactions with other organisms, and each species has a typical adult size range. NRC Framework Link	**Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)

8

8-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

Clarification Statement: *Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.*
State Assessment Boundary: *Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**LS3.A: Inheritance of Traits** Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. NRC Framework Link **LS3.B: Variation of Traits** In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. NRC Framework Link	**Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)

8-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Clarification Statement: *Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause-and-effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.*
State Assessment Boundary: *Assessment should be limited to Punnett squares of monohybrid cross.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**LS1.B: Growth and Development of Organisms** Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary)* NRC Framework Link **LS3.A: Inheritance of Traits** Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. NRC Framework Link **LS3.B: Variation of Traits** In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. In asexual reproduction, an organism's DNA is replicated and passed to its offspring creating a genetic copy of the parent. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships may be used to predict phenomena in natural systems. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
8-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operated in the past as they do today. ***Clarification Statement:*** *Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.* ***State Assessment Boundary:*** *Assessment does not include the names of individual species or geological eras in the fossil record.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 6-8 builds on K-5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings. NRC Framework Link	**LS4.A: Evidence of Common Ancestry and Diversity** The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. NRC Framework Link **ESS2.E: Biogeology** Sudden changes in conditions (e.g., meteor impacts, major volcanic eruptions) have caused mass extinctions, but these changes, as well as more gradual ones, have ultimately allowed other life forms to flourish. *(secondary)* NRC Framework Link	**Patterns** Graphs, charts, and images can be used to identify patterns in data. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
8-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer their ancestral relationships. ***Clarification Statement:*** *Emphasis is on explanations of the ancestral relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.* ***State Assessment Boundary:*** *Assessment of comparisons is limited to gross appearance of anatomical structures.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. NRC Framework Link	**LS4.A: Evidence of Common Ancestry and Diversity** Anatomical similarities and differences among modern organisms and between modern and fossil organisms in the fossil record enable the reconstruction of the history and the inference of lines of ancestral relationships. NRC Framework Link	**Patterns** Patterns can be used to identify cause-and-effect relationships. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4) 8

8-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individual's probability of surviving and reproducing in a specific environment.

Clarification statement: *In a specific environment impacted by different factors, some traits provide advantages that make it more probable that an organism will be able to survive and reproduce there.*
State Assessment boundary: *Assessment is limited to using simple probability statements and proportional reasoning to construct explanations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. NRC Framework Link	**LS4.B: Natural Selection** Natural selection leads to the predominance of certain traits in a population, and the suppression of others. NRC Framework Link	**Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)

8-LS4-5. Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Clarification Statement: *Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and on the impacts these technologies have on society and scientific discoveries.*
State Assessment Boundary: *Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. NRC Framework Link	**LS4.B: Natural Selection** In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. NRC Framework Link	**Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
8-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. ***Clarification Statement:*** *Emphasis on student explanation of trends in data using mathematical models, probability statements, and proportional reasoning to support explanations of trends of population changes.* ***State Assessment Boundary:*** *Assessment does not include Hardy Weinberg calculations.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. Use mathematical representations to support scientific conclusions and design solutions. NRC Framework Link	**LS4.C: Adaptation** Adaptation by natural selection occurring over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not, become less common. Thus, the distribution of traits in a population changes. NRC Framework Link	**Cause and Effect** Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability. NRC Framework Link

Earth's Place in the Universe (ESS1)

8-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, tides, and seasons.

Clarification Statement: *Examples of models can be physical, graphical, or conceptual.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**ESS1.A: The Universe and Its Stars** Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. NRC Framework Link **ESS1.B: Earth and the Solar System** This model of the solar system can explain tides (including spring and neap), eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. NRC Framework Link	**Patterns** Patterns can be used to identify cause- and-effect relationships. NRC Framework Link

Earth's Place in the Universe (ESS1)		
8-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. ***Clarification Statement****: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).* ***State Assessment Boundary:*** *Assessment does not include Kepler's laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 6-8 builds on K-5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. NRC Framework Link	**ESS1.A: The Universe and Its Stars** Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. NRC Framework Link **ESS1.B: Earth and the Solar System** The solar system consists of the sun, planets, their moons, and other celestial objects that are held in orbit around the sun by its gravitational pull on them. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. NRC Framework Link	**Systems and System Models** Models can be used to represent systems and their interactions. NRC Framework Link

Earth's Place in the Universe (ESS1)

8-ESS1-3. Evaluate information to determine scale properties of objects in the solar system.

Clarification Statement: *Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of a celestial object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.*
State Assessment Boundary*: Assessment does not include recalling facts about properties of the planets and other solar system bodies.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods. Integrate qualitative and/or quantitative scientific and/or technical information in text with that contained in media and visual displays to clarify claims and findings. NRC Framework Link	**ESS1.B: Earth and the Solar System** The solar system consists of the sun, planets, their moons, and other celestial objects that are held in orbit around the sun by its gravitational pull on them. NRC Framework Link ETS 2 **ETS2.A: Interdependence of Science, Engineering, and Technology** Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. NRC Framework Link	**Scale, Proportion, and Quantity** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. NRC Framework Link

Biology

South Carolina biology students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in biology help students engage in inquiry questions such as, **but not limited to:**

How do the structures of organisms enable life's functions? Students explain how cells are the basic units of life and the role specialized cells play in maintenance and growth. Students develop models that illustrate the hierarchical system of organizations and how cell division allows for growth, repair, and maintenance of complex organisms. Students design experiments to illustrate how systems of cells function together to support life processes.

How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems? Students explain interactions among organisms and their environment and how organisms obtain and use resources. Students use mathematical concepts to construct explanations for the role of energy in the cycling of matter. Students examine complex interactions among all organisms and design solutions to lessen the effects of changes to ecosystems.

How do organisms interact with the living and non-living environment to obtain matter and energy?
Students use evidence to evaluate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. Students evaluate interactions among organisms, including humans, and how those interactions influence the dynamics and health of ecosystems, and biodiversity.

How are the characteristics from one generation related to the previous generation?
Students ask questions to clarify the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. Students also use data and mathematical evidence to explain why individuals of the same species vary in how they look, function, and behave.

How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How do humans affect biodiversity?
Students explain with evidence factors causing natural selection, the process of evolution of species over time, and how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. Students engage in the engineering design process to investigate and test solutions to reduce the human impact on biodiversity.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Biology

Through the biology performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In biology, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Asking Questions and Defining Problems • Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS3) • Life Science (LS1, LS2, LS3, LS4) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter • Structure and Function • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

From Molecules to Organisms: Structures and Processes (LS1)		
B-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. ***State Assessment Boundary:*** *Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS1.A: Structure and Function** Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information, in the form of DNA. Genes are specific regions within the extremely large DNA molecules that form the chromosomes. Genes contain the instructions that code for the formation of molecules called proteins, which carry out most of the work of cells to perform the essential functions of life. Proteins provide structural components, serve as signaling devices, regulate cell activities, and determine the performance of cells through their enzymatic actions NRC Framework Link **LS3.A: Inheritance of Traits** The sequence of nucleotides spells out the information in a gene. DNA controls the expression of proteins by being transcribed into a "messenger" RNA, which is translated in turn by the cellular machinery into a protein. NRC Framework Link	**Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)		
B-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. ***Clarification Statement:*** *Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.* ***Sate Assessment Boundary:*** *Assessment does not include interactions and functions at the molecular or chemical reaction level.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. NRC Framework Link	**LS1.A: Structure and Function** Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. NRC Framework Link	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

B-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Clarification Statement: *Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels.*
State Assessment Boundary: *Assessment does not include the cellular and chemical processes involved in the feedback mechanism.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. NRC Framework Link	**LS1.A: Structure and Function** Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. NRC Framework Link	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)		
B-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. ***Clarification Statement:*** *Emphasis is on normal cell division as well as instances in which cell division is uncontrolled (e.g., cancer).* ***State Assessment Boundary:*** *Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. NRC Framework Link	**LS1.B: Growth and Development of Organisms** In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow (and repair). The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. NRC Framework Link	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)		
B-LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. ***Clarification Statement:*** *Emphasis is on explaining inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.* ***State Assessment Boundary:*** *Assessment does not include specific biochemical steps.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model based on evidence to illustrate the relationships between systems or between components of a system. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. NRC Framework Link	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

B-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and other large carbon-based molecules necessary for essential life processes.

Clarification Statement: *Emphasis is on using evidence from models and simulations to support explanations of how the products of photosynthesis can be used to form the molecules of life.*
State Assessment Boundary: *Assessment does not include the details of the specific chemical reactions or molecular identification of macromolecules.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** The sugar molecules thus formed contain carbon, hydrogen, and oxygen: the hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for essential life functions. As matter and energy flow through organizational levels of living systems, chemical elements are recombined to form different products. NRC Framework Link	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. NRC Framework Link

From Molecules to Organisms: Structures and Processes (LS1)

B-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

Clarification Statement: *Emphasis is on the conceptual understanding of the inputs and outputs of the processes of aerobic and anaerobic cellular respiration.*
State Assessment Boundary: *Assessment should not include identification of the steps or specific processes involved in cellular respiration nor specific types of fermentation. Assessment should be limited to comparing efficiency of aerobic and anaerobic cellular respiration.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model based on evidence to illustrate the relationships between systems or between components of a system. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken, and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. Anaerobic cellular respiration follows a different and less efficient chemical pathway to provide energy in cells. NRC Framework Link	**Energy and Matter** Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)

B-LS2-1. Use mathematical and/or computational representations to support explanations of biotic and abiotic factors that affect carrying capacity of ecosystems at different scales.

Clarification Statement: *Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and challenges. Examples of mathematical comparisons could include graphs, charts, histograms, or population changes gathered from simulations and historical data sets. Examples of scales could be a pond versus an ocean.*
State Assessment Boundary: *Assessment does not include deriving mathematical equations to make comparisons.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical and/or computational representations of phenomena or design solutions to support explanations. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. NRC Framework Link	**Scale, Proportion, and Quantity** The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)

B

B-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Clarification Statement: *Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.*
State Assessment Boundary: *Assessment is limited to provided data.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to support and revise explanations. NRC Framework Link	**LS2.A: Interdependent Relationships in Ecosystems** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. NRC Framework Link **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more (continued on next page)	**Scale, Proportion, and Quantity** Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. NRC Framework Link

	or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. [NRC Framework Link]	

Ecosystems: Interactions, Energy, and Dynamics (LS2)

B-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

Clarification Statement: *Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in the conservation of matter and flow of energy into, out of, and within various ecosystems.*
State Assessment Boundary: *Assessment focuses on the conceptual understanding and does not include the specific chemical processes of either aerobic or anaerobic respiration.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. NRC Framework Link	**Energy and Matter** Energy drives the cycling of matter within and between systems. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)

B-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Clarification Statement: *Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on conservation of carbon, oxygen, hydrogen, and nitrogen as they move through an ecosystem.*
State Assessment Boundary: *Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to support claims. NRC Framework Link	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. NRC Framework Link	**Energy and Matter** Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)		
B-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. ***Assessment Boundary:*** *Assessment does not include the specific chemical steps of photosynthesis and respiration.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or components of a system. NRC Framework Link	**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems** Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. NRC Framework Link **PS3.D: Energy in Chemical Processes and Everyday Life** The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (*secondary*) NRC Framework Link	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. NRC Framework Link

B-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.

Clarification Statement: *Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. NRC Framework Link	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. NRC Framework Link	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

Ecosystems: Interactions, Energy, and Dynamics (LS2)

B-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on biodiversity and ecosystem health.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. NRC Framework Link	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. NRC Framework Link **LS4.D: Biodiversity and Humans** Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(secondary)* Humans depend on the living world for the resources and other benefits provided by biodiversity. Human activity is having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. These problems have the potential to cause biological extinctions which result in decreased biodiversity and the effects may be harmful to (continued on next page)	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

	LS4.D: Biodiversity and Humans (Cont.) humans and other living things. Sustaining biodiversity so that ecosystem functioning, and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(secondary)* NRC Framework Link **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary)* NRC Framework Link	

Ecosystems: Interactions, Energy, and Dynamics (LS2)

B-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Clarification Statement: *Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, or herding, and cooperative behaviors such as hunting, migrating, or swarming.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the evidence behind currently accepted explanations to determine the merits of arguments. NRC Framework Link	**LS2.D: Social Interactions and Group Behavior** Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)

B-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

State Assessment Boundary: *Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process (including gene regulation).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions that arise from examining models or a theory to clarify relationships. NRC Framework Link	**LS1.A: Structure and Function** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(secondary)* NRC Framework Link **LS3.A: Inheritance of Traits** Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)		
B-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. ***Clarification Statement:*** *Emphasis is on using data to support arguments for the way genetic variation occurs.* ***State Assessment Boundary:*** *Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. NRC Framework Link	**LS3.B: Variation of Traits** In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

Heredity: Inheritance and Variation of Traits (LS3)		
B-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. ***Clarification Statement:*** *Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.* ***State Assessment Boundary:*** *Assessment does not include Hardy-Weinberg or Chi-square analysis.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. NRC Framework Link	**LS3.B: Variation of Traits** Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors. NRC Framework Link	**Scale, Proportion, and Quantity** Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)

B-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Clarification Statement: *Emphasis is on students' conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.*
State Assessment Boundary: *Assessment is limited to conceptual explanations of the evidence for biological evolution and is not extended to the lines of evidence for specific species. Assessment does not include classification of organisms.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). NRC Framework Link	**LS4.A: Evidence of Common Ancestry and Diversity** Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; notably, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** The understanding of evolutionary relationships has recently been greatly accelerated by using new molecular tools to study biology. NRC Framework Link	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)

B-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

Clarification Statement: *Emphasis is on using evidence to explain the influence each of the four factors has on the number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.*
State Assessment Boundary: *Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. NRC Framework Link **LS4.C: Adaptation** Evolution is driven by the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

B-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

Clarification Statement: *Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.*
State Assessment Boundary: *Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. NRC Framework Link	**LS4.B: Natural Selection** Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. NRC Framework Link **LS4.C: Adaptation** Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an (continued next page)	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. NRC Framework Link

	advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change. [NRC Framework Link]	

Biological Evolution: Unity and Diversity (LS4)		
B-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. ***Clarification Statement:*** *Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.* ***State Assessment Boundary:*** *Assessment does not include allele frequency calculations.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**LS4.C: Adaptation** Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)		
B-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. ***Clarification Statement:*** *Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science. Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. NRC Framework Link	**LS4.C: Adaptation** Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

Biological Evolution: Unity and Diversity (LS4)

B-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.

Clarification Statement: *Emphasis is on testing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Create or revise a simulation of a phenomenon, designed device, process, or system. NRC Framework Link	**LS4.C: Adaptation** Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline — and sometimes the extinction — of some species. NRC Framework Link **LS4.D: Biodiversity and Humans** Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. NRC Framework Link (continued on next page)	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

	ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (*secondary*) Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (*secondary*) NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems, including those related to agriculture, health, water, energy, transportation (e.g., wildlife corridors), manufacturing, construction, and communications. *(secondary)* Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. *(secondary)* NRC Framework Link	

Chemistry

South Carolina chemistry students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in chemistry help students engage in inquiry questions such as, **but not limited to:**

How can one explain the structure and properties of matter? Using the patterns in the periodic table, students predict properties of elements, substructure of atoms and trends.

How do substances combine or change (react) to make new substances? How does one characterize and explain these reactions and make predictions about them?
Students explain simple chemical reactions and patterns of chemical properties. Using chemical reactions, students conduct substance structure and particle force investigations, illustrate energy changes, explain reaction rates, refine a chemical system in equilibrium, support a claim of energy conservation and illustrate changes to nuclei composition.

How can one explain and predict interactions between objects and within systems of objects?
Students build an understanding of attraction and repulsion between electric charges at the atomic scale explaining the structure, properties and transformations of matter as well as electrostatic forces between objects.

How is energy transferred and conserved?
Students investigations concerning macroscopic and the subatomic energy can account for either motions of particles or energy associated with the configuration (relative positions) of particles.

How are waves/particles used to transfer energy and send and store information?
Students evaluate and communicate how wave/particle properties and the interactions of electromagnetic radiation with matter can transmit and capture information and energy.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Chemistry

Through the chemistry performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In chemistry, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS1, PS2, PS3, PS4) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Systems and System Models • Energy and Matter • Structure and Function • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Matter and Its Interactions (PS1)

C-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Clarification Statement: *Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.*
State Assessment Boundary: *Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Use a model to predict the relationships between systems or between components of a system. NRC Framework Link	**PS1.A: Structure and Properties of Matter** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. NRC Framework Link	**Patterns** Different patterns may be observed at which a system is studied and can provide evidence for causality in explanations of phenomena. NRC Framework Link

Matter and Its Interactions (PS1)		
C-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. ***Clarification Statement:*** *Examples of chemical reactions could include the reaction of sodium and chlorine, carbon and oxygen, carbon and hydrogen, or biochemical reactions.* ***State Assessment Boundary:*** *Assessment is limited to chemical reactions involving main group elements and combustion reactions.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**PS1.A: Structure and Properties of Matter** The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. NRC Framework Link **PS1.B: Chemical Reactions** The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. NRC Framework Link	**Patterns** Different patterns may be observed at which a system is studied and can provide evidence for causality in explanations of phenomena. NRC Framework Link

Matter and Its Interactions (PS1)		
C-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at a bulk scale to infer the strength of various forces between particles. ***Clarification Statement:*** *Emphasis is on understanding the strengths of forces between particles, NOT on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Macroscopic properties of substances at the bulk scale could include the melting point and boiling point, vapor pressure, and surface tension.* ***State Assessment Boundary:*** *Assessment does not include Raoult's law calculations of vapor pressure.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. NRC Framework Link	**PS1.A: Structure and Properties of Matter** The structure and interactions of matter at the broader level are determined by various forces within and between atoms. NRC Framework Link **PS2.B: Types of Interactions** Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. NRC Framework Link	**Patterns** Different patterns may be observed at which a system is studied and can provide evidence for causality in explanations of phenomena. NRC Framework Link

Matter and Its Interactions (PS1)

C-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

Clarification Statement: *Emphasis is on the idea that a chemical reaction is a system that affects the energy change and is due to the absorption of energy when bonds are broken and the release of energy when new bonds are formed. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved. Examples could include photosynthesis and cell respiration.*
State Assessment Boundary: *Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Model Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. NRC Framework Link	**PS1.A: Structure and Properties of Matter** A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. NRC Framework Link **PS1.B: Chemical Reactions** Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. NRC Framework Link	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. NRC Framework Link

Matter and Its Interactions (PS1)

C-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

Clarification Statement: *Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules. Examples could include enzymes or biocatalytic reactions.*
State Assessment Boundary: *Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. NRC Framework Link	**PS1.B: Chemical Reactions** Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. NRC Framework Link	**Patterns** Different patterns may be observed at which a system is studied and can provide evidence for causality in explanations of phenomena. NRC Framework Link

Matter and Its Interactions (PS1)

C-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Clarification Statement: *Emphasis is on the application of Le Chatelier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants, removing products, or chemical kinetics.*
State Assessment Boundary: *Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. NRC Framework Link	**PS1.B: Chemical Reactions** In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary)* NRC Framework Link	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

Matter and Its Interactions (PS1)

C-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Clarification Statement: *Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale (stoichiometry). Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem- solving techniques.*

State Assessment Boundary: *Assessment does not include complex chemical reactions.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena to support claims. NRC Framework Link	**PS1.B: Chemical Reactions** The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. NRC Framework Link	**Energy and Matter** The total amount of energy and matter in closed systems is conserved. NRC Framework Link

Matter and Its Interactions (PS1)

C-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

Clarification Statement: *Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.*
State Assessment Boundary: *Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Model Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. NRC Framework Link	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. NRC Framework Link	**Energy and Matter** In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)

C-PS2-6. Communicate scientific and technical information about why the molecular structure determines the functioning of designed materials.

Clarification Statement: *Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.*
State Assessment Boundary: *Assessment is limited to provided molecular structures of specific designed materials.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and technical information (e.g., about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). NRC Framework Link	**PS1.A: Structure and Properties of Matter** The structure and interactions of matter at the broader level are determined by various forces within and between atoms. NRC Framework Link **PS2.B: Types of Interactions** Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Determining what constitutes "best," however, requires value judgments, given that one person's view of the optimal solution may differ from another's. *(secondary)* NRC Framework Link	**Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. NRC Framework Link

Energy (PS3)

C-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Clarification Statement: *Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.*
State Assessment Boundary: *Assessment is limited to investigations based on materials and tools provided to students.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. NRC Framework Link	**PS3.B: Conservation of Energy and Energy Transfer** Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). NRC Framework Link **PS3.D: Energy in Chemical Processes and Everyday Life** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. NRC Framework Link	**Systems and System Models** When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)

C-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

Clarification Statement: *Emphasis is on the idea that particles associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.*
State Assessment Boundary: *Assessment is limited to qualitative descriptions.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. NRC Framework Link	**PS4.B: Electromagnetic Radiation** When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. Atoms of each element emit and absorb characteristic frequencies of light and nuclear transitions have distinctive gamma ray wavelengths, which allows identification of the presence of an element. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)

C-PS4-5. Communicate technical information about how some technological devices use the principles of the electromagnetic spectrum to cause matter to transmit and capture information and energy.

Clarification Statement: *Examples could include medical imaging and communications technology.*
State Assessment Boundary: *Assessments are limited to qualitative information. Assessments do not include band theory.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). NRC Framework Link	**PS4.B: Electromagnetic Radiation** Photoelectric materials emit electrons when they absorb light of a high-enough frequency. NRC Framework Link **PS4.C: Information Technologies and Instrumentation** Multiple technologies based on the understanding of energy and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Science and engineering complement each other in the cycle known as research and development (R&D). *(secondary)* NRC Framework Link (continued next page)	**Cause and Effect** Systems can be designed to cause a desired effect of energy interactions of matter. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World Modern civilization depends on major technological systems. *(secondary)* NRC Framework Link	

Physics

South Carolina physics students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in physics help students engage in inquiry questions such as, **but not limited to:**

How can one explain and predict interactions between objects and within systems of objects?
Students build an understanding of forces and interactions, as well as total momentum of a system of objects. Students also predict the gravitational and electrostatic forces between objects. Students apply scientific and engineering ideas to design, evaluate as well as investigate the relationship between electric current and magnetic fields.

How is energy transferred and conserved?
Students illustrate that energy at the macroscopic level can be explained by motion of particles or energy associated with the configuration (relative positions) of particles at the atomic scale. Students apply scientific and engineering ideas to design, build, and refine a device that converts one form of energy into another.

How are waves/particles used to transfer energy and send and store information?
Students support a claim that wave/particle properties are related and evaluate the interactions of electromagnetic radiation with matter in transmission and capture of information and energy.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Physics

Through the physics performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

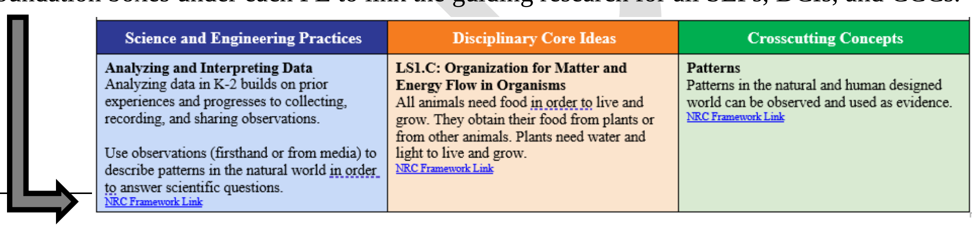
Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In physics, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS2, PS3, PS4) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Systems and System Models • Energy and Matter • Structure and Function • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.



Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Motion and Stability: Forces and Interactions (PS2)		
P-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. ***Clarification Statement:*** *Examples of data could include tables or graphs of position or velocity of an object as a function of time. Examples of objects subjected to a net force could include objects in free-fall, objects sliding down a ramp, or moving objects pulled by a constant force.* ***State Assessment Boundary:*** *Assessment is limited to macroscopic objects moving in one-dimensional motion, at non-relativistic speeds.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. NRC Framework Link	**PS2.A: Forces and Motion** Newton's second law accurately predicts changes in the motion of macroscopic objects (Fnet=ma). NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlations and make claims about specific causes and effects. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)		
P-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. ***Clarification Statement:*** *Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.* ***State Assessment Boundary:*** *Assessment is limited to systems of two macroscopic bodies moving in one dimension.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena to describe and/or support claims and/or explanations. NRC Framework Link	**PS2.A: Forces and Motion** Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. NRC Framework Link	**Systems and System Models** When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)		
P-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the effect of a force on a macroscopic object during a collision.		
Clarification Statement: *An example of evaluation could include determining the success of the device at protecting an object from damage. Examples of devices could include football helmets, parachutes, and car restraint systems, such as seatbelts and airbags. Refinement of the device could include modifying one or more parts or all of the device to improve performance of the device.* ***State Assessment Boundary:*** *Assessment is limited to qualitative evaluations, algebraic manipulations, or both.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and trade off considerations. NRC Framework Link	**PS2.A: Forces and Motion** If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. NRC Framework Link **ETS1.A: Defining and Delimiting Engineering Problems** Criteria may include satisfying cost, safety, reliability, aesthetics requirements and taking into account constraints regarding social, cultural, and environmental impacts. NRC Framework Link **ETS1.B: Developing Possible Solutions** The aim of engineering is to design the best solution under clearly defined constraints and criteria, but there is often no one best solution. NRC Framework Link (continued on next page)	**Cause and Effect** Systems can be designed to cause a desired effect. NRC Framework Link

	ETS1.C: Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically. Trade-offs among the criteria will need to be analyzed, and certain criteria may need to be prioritized over others. NRC Framework Link	

Motion and Stability: Forces and Interactions (PS2)

P-PS2-4. Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects.

Clarification Statement: *Emphasis is on both quantitative and conceptual descriptions of interactions between masses in gravitational fields and electrical charges in electric fields.*
State Assessment Boundary: *Assessment is limited to systems with two objects.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena to describe and/or support claims and/or explanations. NRC Framework Link	**PS2.B: Types of Interactions** Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. NRC Framework Link	**Patterns** Different patterns may be observed at each of the scales at which a system is studied and can provide for causality in explanations of phenomena. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)		
P-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. ***Clarification Statement:*** *Examples could include current carrying wires and electromagnets/solenoids in motors, anti-shoplifting devices, junkyard magnets, metal detectors, and magnetic levitation in high-speed trains.* ***State Assessment Boundary:*** *Assessment is limited to planning and conducting investigations with provided materials and tools.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence. During the planning process: decide on types, how much, and accuracy of data needed to produce reliable measurements, consider limitations on the precision of the data (such as number of trials, cost, risk, time), and refine the design accordingly. NRC Framework Link	**PS2.B: Types of Interactions** Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. NRC Framework Link **PS3.A: Definitions of Energy** "Electrical Energy" may mean energy stored in battery or energy transmitted by electric current. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlations and make claims about specific causes and effects. NRC Framework Link

Motion and Stability: Forces and Interactions (PS2)

P-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Clarification Statement: *Emphasis is on the attractive and repulsive forces that determine the functioning of the material, and transfer of electric charge. Examples of designed conductive materials could include wiring in phone chargers, wiring in car speakers, or computer chips. Examples of designed insulating materials could include polystyrene and fiberglass.*
State Assessment Boundary: *Assessment is limited to molecular structures that are given or provided to students during instruction.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and/or technical information about phenomena and performance of a proposed process or system. Communication can be in multiple formats including orally, graphically, textually, and mathematically. NRC Framework Link	**PS2.B: Types of Interactions** Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. NRC Framework Link ETS2 **ETS2.A: Interdependence of Science, Engineering, and Technology** Engineers continuously modify these technological systems by applying scientific knowledge. *(secondary)* NRC Framework Link (continued on next page)	**Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World Modern civilization depends on major technological systems which can have deep impacts on society and the environment. *(secondary)* NRC Framework Link	

Energy (PS3)

P-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the following are known: 1) the change in energy of the other component(s) and 2) the energy flowing in and out of the system.

Clarification Statement: *Emphasis is on explaining the calculations in the computational model. Examples of computational models could include diagrams, drawings, descriptions, mathematical equations, and computer simulations.*
State Assessment Boundary: *Assessment is limited to basic algebraic equations, to systems of two or three components, and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Create a computational model or simulation of a phenomenon, designed device, process, or system. NRC Framework Link	**PS3.A: Definitions of Energy** Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. A system's total energy is 1) conserved as energy is transferred within the system from one object to another and between its various possible forms and 2) always equal to the energy transferred into or out of the system. NRC Framework Link **PS3.B: Conservation of Energy and Energy Transfer** Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (continued on next page)	**Systems and System Models** Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. NRC Framework Link

	PS3.B: Conservation of Energy and Energy Transfer (Cont.) Mathematical expressions allow the concept of conservation of energy to be used to predict and describe system behavior. Mathematical expressions quantify how the stored energy in a system depends on its configurations (such as relative positions of charged particles or compression of a spring) and how kinetic energy depends on mass and speed. The availability of energy limits what can occur in any system. NRC Framework Link	

Energy (PS3)		
P-PS3-2. Develop and use models to illustrate that energy can be explained by the combination of motion and position of objects at the macroscopic scale and the motion and position of particles at the microscopic scale ***Clarification Statement:*** *Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the Earth (as stored in fields), and the energy stored between two electrically charged plates. Examples of models could include diagrams, drawings, descriptions, or computer simulations.* ***State Assessment Boundary:*** *Assessment does not include quantitative calculations.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components. NRC Framework Link	**PS3.A: Definitions of Energy** Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. Energy at the macroscopic level can be better understood, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases, the relative position (continued on next page)	**Energy and Matter** Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. NRC Framework Link

	energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. [NRC Framework Link]	

P-PS3-3. **Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.**

Clarification Statement: *Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, speakers, or generators. Examples of constraints placed on a device could include the cost of materials, types of materials available, having to use renewable energy, an efficiency threshold, and time to build and/or operate the device.*

State Assessment Boundary: *Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations. NRC Framework Link	**PS3.A: Definitions of Energy** At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. NRC Framework Link **PS3.D: Energy in Chemical Processes and Everyday Life** Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. NRC Framework Link **ETS1.A: Defining and Delimiting an Engineering Problem** Criteria may include satisfying cost, safety, reliability, aesthetics requirements and taking into account constraints regarding social, cultural, and environmental impacts. NRC Framework Link (continued on next page)	**Energy and Matter** Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. NRC Framework Link

	ETS1.B: Developing Possible Solutions The aim of engineering is to design the best solution under clearly defined constraints and criteria, but there is often no one best solution. NRC Framework Link **ETS1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systematically. Trade-offs among the criteria will need to be analyzed, and certain criteria may need to be prioritized over others. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology.** Engineers continuously modify these technological systems by applying scientific knowledge. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems which can have deep impacts on society and the environment. *(secondary)* NRC Framework Link	

Energy (PS3)

P-PS3-5. Develop and use a model to illustrate the forces between two objects and the changes in energy of the objects due to their interaction through electric or magnetic fields.

Clarification Statement: *Examples of models could include drawings, diagrams, descriptions, or computer simulations.*
State Assessment Boundary: *Assessment is limited to systems containing two objects.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components. NRC Framework Link	**PS3.C: Relationship Between Energy and Forces** When two objects interacting through a field change relative position, the energy stored in the field is changed. Each force between the two interacting objects acts in the direction such that the motion in that direction would reduce the energy in the force field between the objects. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)		
P-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. ***Clarification Statement:*** *Examples of different media that could be explored include electromagnetic radiation traveling in a vacuum or glass, sound waves traveling through air or water, or seismic waves traveling through Earth.* ***State Assessment Boundary:*** *Assessment is limited to algebraic relationships and describing relationships qualitatively.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 and experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. NRC Framework Link	**PS4.A: Wave Properties** The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. The reflection, refraction, and transmission of waves at an interface between two media can be modeled on the bases of wave properties. NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)

P-PS4-2. Design, evaluate, and refine a solution for improving how digital devices store and transmit information.

Clarification Statement: *Examples of design problems could include poor signal strength in rural areas with satellite radio or internet connections, lack of security on social media applications (reducing personal data theft), and low quality images (pixelated/fuzzy images, small size). Examples of evaluating the stability of the solution could include determining how successful the solution is at improving signal strength, preventing hacking, and improving image quality.*
State Assessment Boundary: *Assessment is limited to designed solutions with qualitative analysis of wave properties through drawings, diagrams, or computer simulations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations. NRC Framework Link	**PS4.A: Wave Properties** Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this stable form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. Combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. NRC Framework Link **ETS1.B: Developing Possible Solutions** The aim of engineering is to design the best solution under clearly defined constraints and criteria, but there is often no one best solution. NRC Framework Link (continued on next page)	**Stability and Change** Systems can be designed for greater or lesser stability. NRC Framework Link

	ETS2.A: Interdependence of Science, Engineering, and Technology Engineers continuously modify these technological systems by applying scientific knowledge. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems, which can have deep impacts on society and the environment. NRC Framework Link	

Waves and Their Applications in Technologies for Information Transfer (PS4)		
P-PS4-3. Evaluate the claims, evidence, and reasoning about how electromagnetic radiation can be described either by a wave model or a particle model, and in some situations one model is more useful than the other. ***Clarification Statement:*** *Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.* ***State Assessment Boundary:*** *Assessment does not include using quantum theory.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. NRC Framework Link	**PS4.A: Wave Properties** Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. NRC Framework Link **PS4.B: Electromagnetic Radiation** Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. NRC Framework Link	**Systems and System Models** Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)

P-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

Clarification Statement: *Examples of technology applications could include medical imaging devices, tanning beds, radiation cancer treatments, or potential health concerns related to digital signals. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.*
State Assessment Boundary: *Assessment is limited to qualitative descriptions.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. NRC Framework Link	**PS4.B: Electromagnetic Radiation** When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. NRC Framework Link	**Cause and Effect** Cause-and-effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. NRC Framework Link

Waves and Their Applications in Technologies for Information Transfer (PS4)		
P-PS-4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. ***Clarification Statement:*** *Examples could include solar cells capturing light and converting it to electricity, medical imaging, and communications technology.* ***State Assessment Boundary:*** *Assessments are limited to qualitative information. Assessments do not include band theory.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). NRC Framework Link	**PS4.A: Wave Properties** Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. NRC Framework Link **PS4.B: Electromagnetic Radiation** Photoelectric materials emit electrons when they absorb light of a high-enough frequency. NRC Framework Link **PS4.C: Information Technologies and Instrumentation** Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. NRC Framework Link (continued next page)	**Cause and Effect** Cause-and-effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. NRC Framework Link

	ETS2.A: Interdependence of Science, Engineering, and Technology Engineers continuously modify these technological systems by applying scientific knowledge. *(secondary)* NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems which can have deep impacts on society and the environment. *(secondary)* NRC Framework Link	

Earth and Space Science

South Carolina Earth and space science students engage in thinking and solving problems the way scientists and engineers do to help them better see how science is relevant to their lives. To capitalize on the natural curiosity all students have about the world around them, learning experiences are built around the three dimensions of science: **Science and Engineering Practices (SEPs)**, **Crosscutting Concepts (CCCs)**, and **Disciplinary Core Ideas (DCIs)**. This three-dimensional approach to teaching and learning helps educators provide meaningful learning experiences that offer varied entry points for students from diverse backgrounds.

The **performance expectations** in Earth and space science help students engage in inquiry questions such as, **but not limited to:**

What is the universe and what goes on in stars? What are the predictable patterns caused by Earth's movement in the solar system?
Students use evidence to explain the processes governing the formation, evolution, and workings of the solar system and universe in order to understand how matter in the universe formed and how changes in the behavior of the sun directly affect humans.

How do people reconstruct and date events in Earth's planetary history?
Students construct explanations based on data and evidence for the scales of time over which Earth's processes operate. An important aspect of the Earth and space sciences involves making inferences about events in Earth's history.

How do chemical cycles impact Earth's systems?
Students investigate and describe how water and carbon cycles impact Earth's systems. Students also communicate information on how Earth's systems and life change and influence each other.

What affects climate change and what are the effects?
Students forecast climate changes by analyzing data from models and evaluating the implications on Earth's systems. Students also describe how variations in energy flow in Earth's systems result in climate change and use evidence to create an argument that climate change affects human activity.

How do Earth's systems and humans influence each other?
Students construct explanations of the complex and significant interdependencies between humans and Earth's systems, and evaluate solutions for natural hazards, natural resources, and environmental factors.

***The PEs should be bundled to design classroom experiences. There are multiple ways to bundle the PEs to help students lead inquiry and see connections between ideas, and help teachers facilitate phenomenon-driven learning with efficient use of instructional time.**

Earth and Space Science

Through the Earth and space science performance expectations, students demonstrate grade-appropriate proficiency in each of three dimensions. When students explore **Disciplinary Core Ideas** (Dimension 3), they will do so by engaging in **Science and Engineering Practices** (Dimension 1) and should be supported in making connections to the **Crosscutting Concepts** (Dimension 2) to link their understanding across the four disciplinary core domains.

Each performance expectation contains one **SEP** and one **CCC** to be assessable and represents the student performance goal for the end of instruction; however, other **SEPs** and **CCCs** should be applied by students to support their progress leading up to the end of instruction. In Earth and space science, these **end-of-instruction** **SEPs**, **DCIs**, and **CCCs** include:

SEPs	DCIs	CCCs
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Obtaining, Evaluating, and Communicating Information	• Physical Science (PS1, PS3, PS4) • Earth and Space Science (ESS1, ESS2, ESS3) • Engineering, Technology, and Applications of Science (ETS1, ETS2)	• Patterns • Cause and Effect • Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter • Stability and Change

Hyperlinks within the Standards Document

SC Conceptual Vertical Articulation links: Hover over the above underlined and hyperlinked titles to view links for all SEPs, DCIs, and CCCs.

A Framework for K-12 Science Education links: Hover over titles found within the foundation boxes under each PE to link the guiding research for all SEPs, DCIs, and CCCs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. NRC Framework Link	**LS1.C: Organization for Matter and Energy Flow in Organisms** All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. NRC Framework Link	**Patterns** Patterns in the natural and human designed world can be observed and used as evidence. NRC Framework Link

*Equity in science education requires that all students are provided with equitable opportunities to learn science and become engaged in science and engineering practices; with access to quality space, equipment, and teachers to support and motivate that learning and engagement; and adequate time spent on science. In addition, the issue of connecting to students' interests and experiences is particularly important for broadening participation in science (NRC Framework, p. 28).

Earth's Place in the Universe (ESS1)

E-ESS1-1. Develop a model based on evidence to illustrate that energy generated by nuclear fusion within the sun (and other stars) radiates to and influences orbiting planets.

Clarification Statement: *Emphasis should be on the energy from nuclear fusion in a star's core (relative to the star's mass and age) radiating to nearby planets as seen in the Earth-Sun system. This energy varies in cyclic and non-cyclic ways over the lifespan of the star. Examples of evidence could include observations of other solar systems, surface fluctuations, electromagnetic radiation emissions, atmospheric interactions, solar incidence, and albedo.*
State Assessment Boundary: *Assessment does not include details of the mechanism of nuclear fusion. Assessment does not include details of the atomic and subatomic processes involved with the sun's nuclear fusion.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Use a Model Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model (including mathematical and computational) to generate data to support explanations, predict phenomena, and analyze systems. NRC Framework Link	**ESS1.A: The Universe and Its Stars** Nuclear fusion within stars releases electromagnetic energy (seen as starlight). Stars go through a sequence of developmental stages over their lifespans--they are formed; evolve in size, mass, and brightness; and eventually burn out. The Sun is a medium sized star that is about halfway through its predicted life span of approximately 10 billion years. The Sun is just one of more than 200 billion stars in the Milky Way galaxy, and the Milky Way is just one of hundreds of billions of galaxies in the universe. NRC Framework Link **PS3.D: Energy in Chemical Processes and Everyday Life** Nuclear fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. *(secondary)* NRC Framework Link	**Energy and Matter** Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. NRC Framework Link

Earth's Place in the Universe (ESS1)

E-ESS1-2. Construct an explanation of the Big Bang Theory based on evidence to show that the universe is changing over time.

Clarification Statement: *Emphasis is on astronomical evidence that shows the expansion, cooling, and observed composition of the universe. Examples of supporting data include red shift of light from receding galaxies, cosmic microwave background radiation, and spectra of electromagnetic radiation from stars and interstellar gases that match predictions from models of the Big Bang theory.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS1.A: The Universe and Its Stars** The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Stars' radiation of visible light and other forms of energy can be measured and studied to develop explanations about the formation, age, and composition of the universe. The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. NRC Framework Link (continued on next page)	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

	PS4.B: Electromagnetic Radiation Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. *(secondary)* NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. *(secondary)* NRC Framework Link	

Earth's Place in the Universe (ESS1)		
E-ESS1-3. Construct an explanation using evidence to explain the ways elements are produced over the life cycle of a star. ***Clarification Statement:*** *Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime. Emphasis is on the concept that the matter found in our solar system originated from the deaths of other stars. Examples of evidence include data from stars such as composition, temperature, size, mass, and luminosity.* ***State Assessment Boundary:*** *Assessment does not include details of the atomic and subatomic processes involved with nucleosynthesis.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. NRC Framework Link	**ESS1.A: The Universe and Its Stars** The study of stars' light spectra and brightness is used to identify compositional elements of stars. Stars go through a sequence of developmental stages--they are formed; evolve in size, mass, and brightness; and eventually burn out. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. Material from earlier stars that explode as supernovas is recycled to form younger stars and their planetary systems. NRC Framework Link	**Energy and Matter** Energy and matter cannot be created nor destroyed - only moved between one place and another place between objects and/or fields, or between systems. NRC Framework Link

Earth's Place in the Universe (ESS1)		
E-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the universe due to gravity. ***Clarification Statement:*** *Emphasis is on predicting orbital motion of naturally occurring or human-made objects using Kepler's laws and Newton's law of gravity.* ***State Assessment Boundary:*** *Mathematical representations for the gravitational attraction of bodies and Kepler's laws of orbital motions should not deal with more than two bodies, nor involve calculus.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical, computational, and/or algorithmic representations of phenomena to describe and/or support claims and/or explanations. NRC Framework Link	**ESS1.B: Earth and the Solar System** Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. *(secondary)* NRC Framework Link	**Scale, Proportion, and Quantity** Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). NRC Framework Link

Earth's Place in the Universe (ESS1)		
E-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. ***Clarification Statement:*** *Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages of oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core of the continental plate (a result of past plate interactions).*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. NRC Framework Link	**ESS1.C: The History of Planet Earth** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. Tectonic processes continually generate new ocean seafloor at ridges and destroy old seafloor at trenches. NRC Framework Link **ESS2.B: Plate Tectonics and Large-Scale System Interactions** The theory of plate tectonics is supported by evidence of ocean floor spreading over time given by tracking magnetic patterns in undersea rocks and coordinating them with changes to Earth's magnetic axis data. Earth's history is still being written. Continents are continually being shaped and reshaped by competing constructive and destructive geological processes. North America, for example, has gradually grown in size over the past 4 billion years through a complex set of interactions with other continents, including the addition of many new crustal segments. NRC Framework Link	**Patterns** Empirical evidence is needed to identify patterns. NRC Framework Link

Earth's Place in the Universe (ESS1)

E-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

Clarification Statement: *Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed simultaneously along with the rest of the solar system. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. NRC Framework Link	**ESS1.B: The Earth and the Solar System** The solar system consists of the Sun and a collection of objects of varying sizes and conditions. This system appears to have formed from a disk of dust and gas, drawn together by gravity approximately 4.6 billion years ago. NRC Framework Link **ESS1.C: The History of Planet Earth** Radioactive decay lifetimes and isotopic content in rocks provide a way of dating rock formations and thereby fixing the scale of geological time. Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. (continued on next page)	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

	ESS1.C: The History of Planet Earth (Cont.) Studying these objects can provide information about Earth's formation and early history. Study of other planets and their moons, many of which exhibit features such as volcanism and meteor impacts similar to those found on Earth, also help illuminate aspects of Earth's history and changes. NRC Framework Link **PS1.C: Nuclear Processes** Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials thereby fixing the scale of geological time. *(secondary)* NRC Framework Link	

Earth's Systems (ESS2)

E-ESS2-1. Use evidence to argue how Earth's internal and external processes operate to form and modify continental and ocean-floor features throughout Earth's history.

Clarification Statement: *Emphasis is on the core idea that convection leads to the creation and destruction of surface features. Plate movements and many crustal features and events are a result of this phenomenon, but there are other surface processes, which shape Earth's surface as well. The appearance of land features (such as mountains, valleys, coastlines, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion). Examples include seafloor spreading at ridges (evidenced by paleomagnetic data and radiometric dating of rocks), subduction at trenches (evidenced by seismic data and volcanoes), and weathering and erosion among mountains (evidenced by weathering, erosion, and deposition patterns of streams).*
State Assessment Boundary: *Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Construct an oral and written argument or counter- arguments based on data and evidence. NRC Framework Link	**ESS2.A: Earth Materials and Systems** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. A deep knowledge of how feedback works within and among Earth's systems is still lacking, thus limiting scientists' ability to predict some changes and their impacts. The top part of the mantle, along with the crust, forms structures known as tectonic plates. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to long-term tectonic cycles. NRC Framework Link (continued on next page)	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

	ESS2.B: Plate Tectonics and Large-Scale System Interactions The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. The plates move across Earth's surface, carrying the continents, creating and destroying ocean basins, producing earthquakes and volcanoes, and forming mountain ranges and plateaus. Most continental and ocean floor features are the result of geological activity and earthquakes along plate boundaries. The exact patterns depend on whether the plates are being pushed together to create mountains or deep ocean trenches, being pulled apart to form new ocean floor at mid-ocean ridges, or sliding past each other along surface faults. NRC Framework Link	

Earth's Systems (ESS2)		
E-ESS2-2. Analyze data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. ***Clarification Statement:*** *Examples should include climate feedback, such as how an increase in greenhouse gases causes a rise in global temperatures that melt glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures, and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion, how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. NRC Framework Link	**ESS2.A: Earth Materials and Systems** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. Transfers of energy and the movements of matter can cause chemical and physical changes among Earth's materials and living organisms. NRC Framework Link **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. NRC Framework Link (continued on next page)	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. NRC Framework Link

	ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. *(secondary)* NRC Framework Link	

Earth's Systems (ESS2)

E-ESS2-3. Develop a model based on evidence of Earth's interior that describes cycling of matter through convection processes.

Clarification Statement: *Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), volcanoes, and identification of the composition of Earth's layers from high-pressure laboratory experiments.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate and/or predict the relationships between systems or between components. NRC Framework Link	**ESS2.A: Earth Materials and Systems** Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle, and crust. All of Earth's processes are the result of energy flowing and matter cycling within and among Earth systems. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and the gravitational movement of denser materials toward the interior. NRC Framework Link **ESS2.B: Plate Tectonics and Large-Scale System Interactions** The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle providing the (continued on next page)	**Energy and Matter** Energy and matter cannot be created nor destroyed - only moved between one place and another place between objects and/or fields, or between systems. The total amount of energy and matter in closed systems is conserved. NRC Framework Link

	primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. The top part of the mantle, along with the crust, make up the moving tectonic plates of the lithosphere. Tectonic plates ride above giant convection cells that bring matter from the hot inner mantle up to the cool surface. The plates move across Earth's surface, carrying the continents, creating and destroying ocean basins, producing earthquakes and volcanoes, and forming mountain ranges and plateaus. NRC Framework Link **PS4.A: Wave Properties** Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. *(secondary)* NRC Framework Link **ETS2.A: Interdependence of Science, Engineering, and Technology** Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. *(secondary)* NRC Framework Link	

E-ESS2-4. Use a model to describe how causes of short and long-term variations in the flow of energy into and out of Earth's systems result in changes to climate.

Clarification Statement: *Emphasis is on the relationships between components that affect the input, output, storage, and redistribution of energy on Earth. Emphasis is on specific cause-and-effect relationships between the factors that affect energy flow (into and out of Earth's systems) and their effects on climate over different timescales.*
State Assessment Boundary: *Assessment is limited to one example of a climate change and its associated impacts. Assessment of the results of changes in climate is limited to direct changes in climate such as surface temperatures and precipitation patterns.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Use a model based on evidence to illustrate and/or predict the relationships between systems or between components. NRC Framework Link	**ESS1.B: Earth and the Solar System** Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the orientation of the planet's axis of rotation, both occurring over tens to hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on Earth. These phenomena cause cycles of ice ages and other gradual climate changes. *(secondary)* NRC Framework Link **ESS2.D: Weather and Climate** The foundation for Earth's global climate systems is the electromagnetic radiation from the Sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (continued on next page)	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlations and make claims about specific causes and effects. NRC Framework Link

	ESS2.D: Weather and Climate (Cont.) Climate changes, which are defined as significant and persistent changes in an area's average or extreme weather conditions can occur if any of Earth's systems change. Scientists can infer these changes from geological evidence. Some climate changes in Earth's history were rapid shifts (caused by natural events, such as volcanic eruptions and meteoric impacts, which suddenly put a large amount of particulate matter into the atmosphere or by abrupt changes in ocean currents, or variations in solar output). Other climate changes were gradual and longer term--due, for example, to solar output variations, or atmospheric changes due to the rise of plants and other life forms that modified the atmosphere via photosynthesis. The timescale of these changes varies from a few to millions of years. Cumulative increases in the atmospheric concentrations of carbon dioxide and other greenhouse gases, whether arising from natural sources or human industrial activity, increase the capacity of Earth to retain energy. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. NRC Framework Link	

Earth's Systems (ESS2)

E-ESS2-5. Investigate the ways that water (given its unique physical and chemical properties) impacts various Earth systems.

Clarification Statement: *Emphasis should be on water's ability to absorb/store and release energy, transmit sunlight, expand when freezing, and dissolve/transport materials. Examples of system interactions could include the hydrogeologic system (weathering, erosion, deposition, soil formation, groundwater formation, and the rock cycle), energy transfer system (weather and climate), and ecosystems (coral reefs and hydrothermal vents).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence. NRC Framework Link	**ESS2.C: The Roles of Water in Earth's Surface Processes** The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy as it changes state; transmit sunlight; expand upon freezing; dissolve and transport materials; and lower the viscosities and melting points of the material when mixed with fluid rocks within the mantle. Each of these properties plays a role in how water affects other Earth systems (e.g., ice expansion contributes to rock erosion, or ocean thermal capacity contributes to moderating temperature variations). NRC Framework Link	**Cause and Effect** Cause-and-effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. Systems can be designed to cause a desired effect. NRC Framework Link

Earth's Systems (ESS2)		
E-ESS2-6. Develop a quantitative model to describe the cycling of carbon through the hydrosphere, atmosphere, geosphere, and biosphere. ***Clarification Statement:*** *Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (photosynthesis, chemosynthesis, cellular respiration), providing the foundation for living organisms.*		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate and/or predict the relationships between systems or between components. NRC Framework Link	**ESS2.D: Weather and Climate** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. NRC Framework Link	**Energy and Matter** The total amount of energy and matter in closed systems is conserved. NRC Framework Link

Earth's Systems (ESS2)

E-ESS2-7. Communicate scientific information that illustrates how Earth's systems and life on Earth change and influence each other over time.

Clarification Statement: *Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples could include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.*
State Assessment Boundary: *Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific and/or technical information or ideas (e.g. about phenomena) in multiple formats (i.e., orally, graphically, textually, mathematically). Use words, tables, diagrams, and graphs, as well as mathematical expressions to communicate their understanding or to ask questions about a system under study. NRC Framework Link	**ESS2.D: Weather and Climate** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. The time scales of these changes varied from a few to millions of years. NRC Framework Link **ESS2.E: Biogeology** As Earth changes, life on Earth adapts and evolves to those changes, so just as life influences other Earth systems, other Earth systems influence life. Life and the planet's nonliving systems can be said to co-evolve. The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. NRC Framework Link	**Stability and Change** Much of science deals with constructing explanations of how things change and how they remain stable. NRC Framework Link

Earth and Human Activity (ESS3)

E-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources and occurrence of natural hazards have influenced human activity.

Clarification Statement: *Examples of key natural resources could include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting, and soil erosion), and severe weather (such as hurricanes, floods, and droughts).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. NRC Framework Link	**ESS3.A: Natural Resources** Resource availability has guided the development of human society. NRC Framework Link **ESS3.B: Natural Hazards** Natural hazards and other geologic events have shaped the course of human history by destroying buildings and cities, eroding land, changing the course of rivers, and reducing the amount of arable land. These have significantly altered the sizes of human populations and have driven human migrations. Natural hazards can be local, regional, or global in origin, and their risks increase as populations grow. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems. *(secondary)* NRC Framework Link	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlations and make claims about specific causes and effects. NRC Framework Link

Earth and Human Activity (ESS3)

E-ESS3-2. Evaluate competing design solutions that address the impacts of developing, managing, and using Earth's energy and mineral resources.

Clarification Statement: *Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining, forestry, and risk/benefit analysis of the production of conventional, unconventional, or renewable energy resources.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and trade off considerations. NRC Framework Link	**ESS3.A: Natural Resources** All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. New technologies and social regulations can change the balance of these factors. NRC Framework Link **ETS1.A: Defining and Delimiting an Engineering Problem** Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. NRC Framework Link (continued on next page)	**Cause and Effect** Cause-and-effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. NRC Framework Link

	ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Testing should lead to improvements in the design through an iterative procedure. *(secondary)* NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. Analysis of costs and benefits is a critical aspect of decisions about technology. *(secondary)* NRC Framework Link	

Earth and Human Activity (ESS3)

E-ESS3-3. Use computational representation to illustrate the relationships among the management of Earth's resources, the sustainability of human populations, and biodiversity.

Clarification Statement: *Examples of factors that affect the management of natural resources could include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability could include agricultural efficiency, levels of conservation, urban planning, as well as local and international policies.*
State Assessment Boundary: *Assessment for computational thinking is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. When the source of an environmental problem is understood and international agreement can be reached, human activities can be regulated to mitigate global impacts (e.g., acid rain and the ozone hole near Antarctica). NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems. *(secondary)* New technologies can have deep impacts on society and the environment, including some that were not anticipated. *(secondary)* NRC Framework Link	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. NRC Framework Link

Earth and Human Activity (ESS3)

E-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Clarification Statement: *Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. NRC Framework Link	**ESS3.C: Human Impacts on Earth Systems** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. NRC Framework Link **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. Testing should lead to improvements in the design through an iterative procedure. NRC Framework Link **EST2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. NRC Framework Link	**Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. NRC Framework Link

Earth and Human Activity (ESS3)

E-ESS3-5. Analyze data and the results from global climate models to make an evidence-based forecast of the current rate of regional or global climate change and associated future impacts to Earth's systems.

Clarification Statement: *Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).*
State Assessment Boundary: *Assessment is limited to one example of a climate change and its associated impacts.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using computational models in order to make valid and reliable scientific claims. NRC Framework Link	**ESS3.D: Global Climate Change** Global climate models are often used to understand the process of climate change because these changes are complex and can occur slowly over Earth's history. Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. NRC Framework Link	**Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. NRC Framework Link

Earth and Human Activity (ESS3)

E-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Clarification Statement: *Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. One example of this relationship is how human activities can create changes in the atmosphere including an increase in carbon dioxide that has many far-reaching effects, including changes in photosynthetic biomass on land, ocean acidification, and storm intensity.*
State Assessment Boundary: *Assessment does not include running computational representations and is limited to using the published results of scientific computational models.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. NRC Framework Link	**ESS2.D: Weather and Climate** Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. Hence the outcomes depend on human behaviors as well as on natural factors that involve complex feedback among Earth's systems. *(secondary)* NRC Framework Link **ESS3.D: Global Climate Change** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. NRC Framework Link (continued on next page)	**Systems and System Models** When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. NRC Framework Link

	ESS3.B: Natural Hazards Human activities can contribute to the frequency and intensity of some natural hazards. NRC Framework Link	

Earth and Human Activity (ESS3)

E-ESS3-7. Create an argument, based on evidence that describes how changes in climate on Earth have affected human activity.

Clarification Statement: *Emphasis is on changes in climate that influence past, modern, or future human activities. Examples of key changes in climate that can affect populations or drive mass migrations could include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. Construct a scientific argument based on data and evidence. NRC Framework Link	**ESS3.D: Global Climate Change** Impacts of climate change--for example, increased frequency of severe storms due to ocean warming-- have begun to influence human activities. Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities, as well as to changes in human activities. Thus, science and engineering will be essential both to understanding the possible impacts of global climate change and to informing decisions about how to slow its rate and consequences for humanity as well as for the rest of the planet. (continued on next page)	**Cause and Effect** Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. NRC Framework Link

	ESS3.D: Global Climate Change (Cont.) The impacts of climate change are uneven and may affect some regions, species, of human populations more severely than others. By using science-based predictive models, humans can anticipate long-term change more effectively than ever and plan accordingly. NRC Framework Link **ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World** Modern civilization depends on major technological systems. *(secondary)* NRC Framework Link	

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Appendix A: Acknowledgements

South Carolina owes a debt of gratitude to the hundreds of science educators, informal science educators, representatives of higher education, business and industry representatives, community members and leaders, parents, national science education leaders, as well as recent SC graduates who collaborated to produce the *South Carolina College- and Career-Ready Science Standards 2021*.

SC Education Oversight Committee (EOC) Science Standards National Review Panel

The five members of the SC EOC science standards national review panel recommended revisions to the *South Carolina Academic Standards and Performance Indicators for Science 2014.*

Randy LaCross, Vice President for Outreach and Research, SC Governor's School for Science and Mathematics	Dr. Christine Lotter, Associate Professor, University of South Carolina	Peter McLaren, Executive Director, Next Gen Education, Rhode Island
Dr. Robert Tai, Associate Professor, University of Virginia	Dr. Judith Salley, Executive Director, South Carolina State University	

SC Education Oversight Committee (EOC) Science Standards Review Panel

The 43 members of the SC EOC science standards state review panel recommended revisions to the *South Carolina Academic Standards and Performance Indicators for Science 2014.*

Marianne Blake, Beaufort	Kristen Bolin, Gaffney	Tracy Brown, Conway
Sandy Bradshaw, Anderson	Urica Brown, Pawley's Island	Ashley Bryan, Allendale
Christine Burras, Greenville	Dr. G. Nate Carnes, Columbia	Chip Chase, Kingstree
Steve Coolidge, Duncan	Rick Eitel, Moore	Bert Ely, Columbia

Ray Funnye, Georgetown	Deborah Hardison, Bennettsville	Betty Harrington, Manning
Lisa Hartley, Union	Dr. Eric Hayler, Boiling Springs	Dr. John Holton, Columbia
Hubert Jayakumar, Chester	Thomas Kelly, Varnville	Caroline Lemay, Rock Hill
Cathy Little, Laurens	Thomas Moore, Irmo	Dr. Bridget Miller, Columbia
Eileen Fleming-Patona, North Myrtle Beach	Dr. Tom Peters, Clemson	Dr. Mark Pesnell, Easley
Jamey Porter, Beaufort	T'Sheila Praileau, Winnsboro	Robert "Chris" Rice, Lexington
Dr. Akil Ross, Columbia	The Honorable Stu Rodman, Hilton Head	Elizabeth Roorda, York
Dr. Holly Sullivan, Cassatt	Virginia "Brooke" Sledge	Cynthia Spratley, York
Dr. Pam Vereen, Hemmingway	Janet Walker, Union	Christine Ware, Simpsonville
Rosemary Wilson, Lexington	Audrey Winters, Laurens	Hank Wortley, Myrtle Beach
Marilyn Young, Varnville		

SCDE Science Standards Review Panel

The 54 members of the SCDE science standards review panel recommended revisions to the *South Carolina Academic Standards and Performance Indicators for Science 2014.*

Laura Ybarra, Lexington Richland 5	Brandy Incorvia, Horry	Priscilla Towne Summerford, Aiken
Leigh Stuckey, Greenville	Todd Underwood, Virtual SC	Rebecca Jackson, Dorchester 2
Ashley Hinch, Horry	Michelle Schlachter, Aiken	Brielle Kociolek, Berkeley
Meta Van Sickle, Charleston	Saskia LoVine, Greenville	Kishni Neville, Aiken
Leta Tribble, Laurens 56	Ashlee Buchanan, Richland 1	Beth Owings, Anderson 1
Dillon Gary, Greenwood	Vita L. Segars, Richland 1	Jennifer Hines, Abbeville
Rachael Bashor, Columbia	Lori Holbrook, Charleston	Dr. Cassandra Williams, Williamsburg
Amanda Edwards, Columbia	Matt Schnabel, West Columbia	Sarah Camens, Berkeley
Taylor Ashworth, Greenville	Rosemary Wicker, Laurens 56	Melissa Boehler, Richland 1
Kirstin Bullington, Richland 2	Jennifer McMillian, Aiken	Laura Wiggins, Berkeley
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Sharda Jackson Smith, Spartanburg	Kristy Floyd, Horry	Loraine Redwood, Williamsburg

Elaine Finney, Richland 2	Jamey Porter, Beaufort	Taylor Bates, Richland 1
Gary Bartley, Spartanburg 2	Aracely Johnson, Beaufort	Dr. Hadi Hamid, Greenwood
Ashley Zeimer, Greenville	Jenny Treaster, Kershaw	Rachel Enggasser, Greenville
Brandon Mulligan, Charleston	Dr. Jamie Taber, Greenville	Melissa Littleton, Anderson 4
Dr. Golnaz Arastoopour Irgens, Pickens	Cate Buesing, Charleston	Leah Scott, Richland 1

Informal education representation: SC State Museum, EdVenture, Greenwood Genetics Center, Riverbanks Zoo and Garden, S^2TEM Centers, and SC Forestry Division

Business and Industry representation: McCall Farms, Boeing, Milliken, Santee Cooper, Clergy, DHEC, and Proterra Engineering

IHE Representation: Clemson University, College of Charleston, USC Upstate, Piedmont Technical College, and Duke University (student)

SCDE Office representation: Office of Career and Technology Education, Office of Assessment, Office of Virtual SC, and Office of Standards and Learning

SCDE Writing Team

The 49 members of the SCDE science standards writing team wrote the *South Carolina College- and Career-Ready Science Standards 2021.*

Dr. Cassandra Williams, Williamsburg	Samantha Slover, Fairfield	Becky Cornwell, Spartanburg 7
Palvi Mohanty, Aiken	Marsha Neal, Charleston	Jennifer Hines, Abbeville
Kristy Floyd, Horry	Laura Nix, Charleston	Amanda Harris Cole, Greenville
Vita Segars, Richland 1	Jennifer Thompson, Dorchester 2	Callie Dollahon, Charleston

Lori Holbrook, Charleston	Meredith Schwendemann, Greenwood 50	Cori Bell, Marion
Dr. Eleanor Fields, Orangeburg	Kelly Walker, Dorchester 2	Kathrine Moore, Anderson 1
Dr. Jamie Taber, Greenville	Jomia Mack, Florence	Neelam Verma, Lexington 1
Kishni Neville, Aiken	Meredith Rhoden, Beaufort	Melissa Zaremba, Charleston
Golnaz Arastoopour Irgens, Pickens	Jessyca Calhoun, Greenwood 50	Christina Kleindt, Charleston
Renee Covert, Greenville	Donna Moore, Kershaw	Hannah Trado, Anderson 5
Kerri Moore, Spartanburg 2	Saskia LoVine, Greenville	Amy Dherit, Cherokee
Jacqueline Clarke, Charleston	Cate Buesing, Charleston	Dr. Jodi Zeis, Kershaw
Rhonda Dodson, Spartanburg 5	Habibunnisa Begum, Marion	Lizzy Siceloff, Lexington 1
Liz Alvarez, Spartanburg	Cathy Jo Carpenter, Kershaw	Lori Lambert, Lexington 1
Teresa Gibbons, Georgetown	Christina Roberts, Richland 2	Carla Krammer, Charleston
Logan Riley, Dorchester 2	Dr. Lateasha Harris, Lee	Dr. Michiko McClary, Orangeburg
Summer White, Colleton		

Informal education representation: S^2TEM Centers, South Carolina State Museum
IHE Representation: Clemson University, Francis Marion University, Claflin University, Coastal University
SCDE Office representation: Office of Assessment, Office of Standards and Learning

SCDE Local Writing Advisory Team

The 28 members of the SCDE local advisory writing team provided recommendations to the *South Carolina College- and Career- Ready Science Standards 2021*

Amanda Edwards, Columbia	Evangelina Hemphill, Columbia	Matthew Rand, North Charleston
Antonia Craig, Clemson	Jaime Thom, Summerville	Nelson Akwari, Summerville
Ashley Ziemer, Greenville	Dr. Jonathan Brock, Columbia	Rachael Bashor, Columbia
Brandy Incorvia, Myrtle Beach	Julie Binz, Charleston	Rebecca Liu, Durham NC
Carolyn Donelan, Columbia	Leigh Stuckey, Greenville	Salomon Campos-Rice, Columbia
Carole Holmberg, York	Dillon Gary, Greenwood	Sara Green, Columbia
Dr. Christopher Marsh, Beaufort	Dr. Leta Tribble, Greenwood	Sarah Chabaane, Kershaw
Cynthia Spratley, York	Mary Levens, Spartanburg	Travis Dias, Columbia
E.V. Bell, Charleston	Matt Schnabel, Columbia	Rachel Enggasser, Greenville
Cassandra Runyon, Charleston		

Informal education representation: Museum of York County, Spring Island Trust / Low Country Institute, South Carolina Sea Grant Consortium, South Carolina Aquarium, Spartanburg Science Center, SC Forestry Commission & SC Project Learning Tree, Riverbanks Zoo and Garden, South Carolina Wildlife Federation

Business and Industry representation: SC Department of Health and Environmental Control, Santee Cooper, Hemphill Consulting Group, LLC, SC chapter of the American Academy of Pediatrics, South Carolina Department of Natural Resources, Westminster Presbyterian Church, Greenwood Genetics Center, Boeing

IHE Representation: University of North Dakota, Clemson University, Duke University**,** University of South Carolina, College of Charleston

SCDE National Advisory Writing Team

The 10 members of the SCDE national advisory writing team provided recommendations to the *South Carolina College- and Career- Ready Science Standards 2021*.

Colonel Peter Ferguson, Louisiana	John White, North Carolina	Tamara Smolek, Michigan
Elizabeth Joyner, Virginia	Russ Keller, South Carolina	Mary Starr, Michigan
Peter McLaren, Rhode Island	Megan Cannon, Oklahoma	Caitlin Nolby, North Dakota
Tiffany Neill, Oklahoma		

Informal educator representation: Michigan Department of Education, Michigan Mathematics and Science Centers Network, Next Gen Education, LLC, Oklahoma State Department of Education

Business and Industry representation: US Air Force Reserve, NASA Langley Research Center Science System Applications Incorporated, Department of Defense, Advanced Technology International

SCDE Standards Design Team

The 13-member team produced the engineering design process for the *South Carolina College- and Career-Ready Science Standards 2021*.

Callie Dollahon (Graphic Designer), Charleston	Dr. Golnaz Arastoopour Irgens, Pickens	Nelson Akwari, Summerville
Cassandra Runyon, Charleston	Dr. Jamie Taber, Greenville	Col. Peter Ferguson, Louisiana
Caitlyn Nolby, North Dakota	Meredith Rhoden, Beaufort	Russ Keller, Summerville
Evangelina Hemphill, Columbia	Matthew Rand, North Charleston	Salomon Campos-Rice, Florence
Elizabeth Joyner, Virginia	Antonia Craig, Travelers Rest	

Informal educator representation: NASA Langley Research Center

Business and Industry representation: Boeing, Advanced Technology Institute, Hemphill Consulting Engineering Group, LLC, Intelligence for Air Force Global Strike Command

IHE representation: Clemson University (student Engineering candidate), College of Charleston, USC Honors College (student Pre- Law candidate), University of North Dakota

EDUCATION OVERSIGHT COMMITTEE

SUBCOMMITTEE: Academic Standards and Assessments

DATE: May 17, 2021

ACTION ITEM: Annual Report on Academic Performance of Military-Connected Students for 2019-20

PURPOSE/AUTHORITY

Act 289, the Military Family Quality of Life Enhancement Act, was enacted in 2014. The law requires the Education Oversight Committee (EOC) to develop an annual report on the educational performance of military connected children:

> The Education Oversight Committee, working with the State Board of Education, is directed to establish a comprehensive annual report concerning the performance of military connected children who attend primary, elementary, middle, and high schools in this State. The comprehensive annual report must be in a reader-friendly format, using graphics wherever possible, published on the state, district, and school websites, and, upon request, printed by the school districts. The annual comprehensive report must address at least attendance, academic performance in reading, math, and science, and graduation rates of military connected children.

CRITICAL FACTS

EOC staff worked with staff and information from the SC Department of Education, Department of Defense State Liaison Office, and the Military Child Education Coalition.

TIMELINE/REVIEW PROCESS

Report issued annually. The study began in March of 2021 with the collection and analysis of data provided by South Carolina Department of Education and the Department of Defense State Liaison Office.

ECONOMIC IMPACT FOR EOC

Cost: No fiscal impact beyond current appropriations.

Fund/Source: EIA funds appropriated for operation of the agency.

ACTION REQUEST

☒ **For approval** ☐ **For information**

ACTION TAKEN

☐ **Approved** ☐ **Amended**
☐ **Not Approved** ☐ **Action deferred (explain)**

ACADEMIC PERFORMANCE OF MILITARY-CONNECTED STUDENTS

Annual Report for 2019-20

SC EDUCATION
OVERSIGHT COMMITTEE

PO Box 11867 | 227 Blatt Building | Columbia SC 29211 | WWW.SCEOC.ORG

Educational Performance of Military-Connected Students, 2020

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Introduction

In 2014, the General Assembly passed Act 289, the Military Family Quality of Life Enhancement Act. The Act's purpose is to "enhance quality of life issues for members of the armed forces" (Act 289 Preamble). Part V requests the SC Education Oversight Committee (EOC) to develop an annual report on the educational performance of military-connected children:

> The Education Oversight Committee, working with the State Board of Education, is directed to establish a comprehensive annual report concerning the performance of military-connected children who attend primary, elementary, middle, and high schools in this State. The comprehensive annual report must be in a reader-friendly format, using graphics wherever possible, published on the state, district, and school websites, and, upon request, printed by the school districts. The annual comprehensive report must address at least attendance, academic performance in reading, math, and science, and graduation rates of military-connected children.[1]

The EOC evaluation team worked closely with the military and education community as it developed this report. Professionals, who directly support military families, provided input. Both the South Carolina Department of Education (SCDE) and Defense Manpower Data Center provided data. The 2020 report provides:

- An overview of the federal Impact Aid program.
- Details regarding the demographics of military-connected students.
- An update on the academic performance and school attendance of military-connected students as reported for school year 2019-20; and
- A summary of the trainings for educators and families to enhance support of military-connected students at home and in school.

[1] Section 59-18-900(H) of the South Carolina Code of Laws.

Acknowledgements

The EOC is grateful for the assistance of local, state, and national organizations and staff in the development of this report. Report contributors include:

Department of Defense State Liaison Office

Military Child Education Coalition

SC Department of Education

South Carolina School Liaison Office

Summary of Findings

1. Due to COVID-19 school closures and the resulting waiver of end-of-year assessments by the U.S. Department of Education, South Carolina end-of-year summative assessments were not administered in elementary and middle schools, and data is not available for reporting. Military-Connected Students (MCS) data for the Kindergarten Readiness Assessment (KRA), the South Carolina End-of-Course Evaluation Program (EOCEP), Advanced Placement (AP) assessments, Career Technology Assessments, graduation rates, and attendance are included in this report .
2. Data reported by the South Carolina Department of Education (SCDE) regarding military-connected students are based on district entry of student information into PowerSchool. As a state, South Carolina's reporting of the number of military-connected students has improved over time. Data provided by the SCDE to the Education Oversight Committee (EOC) indicate there were 18,237 military-connected students in South Carolina's public schools in school year 2019-20. Almost 70 percent of military-connected students have at least one parent who is active duty, a slight increase from the prior school year.
3. Every Student Succeeds Act (ESSA) requires the identification and collection of military-connected student data, and South Carolina has an established mechanism for collecting this information. SCDE manages PowerSchool, the student data information system that is provided to school districts. It is the primary source for student data and is often used for state and federal reporting requirements. In PowerSchool, a "Parent Military Status" field includes a list with seven possible student status options, as shown below.

Military-Connected Student Data Collected in PowerSchool, as of May 13, 2021[2]

Values
(blank) – Neither Parent nor Guardian is serving in any military service.
01 - A Parent or Guardian is serving Full-time in the National Guard and is not currently deployed.
02 - A Parent or Guardian is serving Full-time in the Reserves and is not currently deployed.
03 - A Parent or Guardian is serving Full-time in the National Guard and is currently deployed.
04 - A Parent or Guardian is serving Full-time in the Reserves and is currently deployed.
05 - A Parent or Guardian is serving in the military on active duty and is not deployed.
06 - A Parent or Guardian is serving in the military on active duty and is currently deployed.

[2] SC State Reporting Updates, Update dated May 13, 2020. Accessed at https://ed.sc.gov/data/information-systems/power-school/sc-state-reporting-updates/.

In response to ESSA, the SCDE provides more detailed academic performance data on military-connected students that can be disaggregated by gender, economic status, English learner status, disability status, gender, homeless status, gifted and talented status, and foster care status.

4. Of the 18,237 military-connected students reported by school districts to SCDE in school year 2019-20, approximately 81 percent of the students attended one of the eleven school districts listed in Table 3. Appendix B provides additional detail for all school districts.

School Districts with Highest Military-Connected Student Populations, School Year 2019-20

District	Students	Percent
Richland 2	4,060	22.26
Horry	2,285	12.52
Dorchester 2	2,032	11.14
Beaufort	1,386	7.59
Berkley	1,173	6.43
Lexington 1	1,091	5.98
Sumter	796	4.36
Kershaw	764	4.19
Aiken	610	3.34
Lexington 5	568	3.11
Total	**14,765**	**80.96**

Source: SC Department of Education, February 2021 data provided to EOC.

5. About 70 percent of military-connected students have at least one guardian or parent who is on active duty or deployed. Approximately 1,992 military-connected students had at least one parent who was deployed in school year 2020, representing an increase of 360 from 2019. An additional 151 military-connected students were reported to have a parent who was on active duty but died within the last year. Another 1087 military-connected students reported having a parent who was on active duty and wounded in 2020. While this category is a small percentage of the total number of military-connected students, the number of military-connected students with a parent who was wounded in 2020 is 38 percent greater than in 2019.

6. Military-connected student data for the Kindergarten Readiness Assessment (KRA) results show that of the 1,235 Military-connected students assessed 47.5% scored ready for Kindergarten, compared to 39.0% of all students tested on this assessment statewide.

7. Military-connected students continue to perform better than their peers (tested students of their same age and grade level). During the 2019-20 school year, military-connected students outperformed all students statewide on the End-of-Course Examination Program (EOCEP) exams (Algebra 1, Biology, and U. S. History) administered at the end of the fall 2019 semester. On average, military-connected students' average scores for the three courses tested were 6.2 points higher. EOCEPs were not administered at the end of the semester in spring 2020.

8. During the 2019-20 school year, the high school graduation rate for military-connected students was 92.5 percent, up from the reported 86.9 percent in 2018-19. The state on-time graduation rate was 82.01 percent, up from 81.05 percent in 2018-19.

9. In 2019-20, of the 68 districts reporting MCS, only 32 districts provided attendance reports. From available data, the average number of days absent for military-connected students was 3.7 days. Thirteen school districts with at least 30 military-connected students reported that military-connected students were absent for more than 3.7 school days. The highest average absence rate was (4.3 days), and the lowest absence rate was 0 days.

I. Identification and Data Reporting on Military-Connected Students

In December 2015, changes to Impact Aid and the identification of military-connected students were enacted due to the congressional passage of Every Student Succeeds Act (ESSA). Under ESSA, the disaggregation of student-level data is required, including the identification, collection and reporting of military-connected students. ESSA also addresses Impact Aid. Funding authorization for Impact Aid remains stagnant. However, some changes to Impact Aid were made:

- technical and formula changes to federal properties that have already reduced program subjectivity and increased timeliness of payments were made permanent.
- the federal properties "lockout" provision that prevented eligible federally impacted school districts from accessing Impact Aid funding was eliminated.
- the basic support formula was adjusted to ensure equal proration when appropriations are sufficient to fund the Learning Opportunity Threshold; and
- a "hold harmless" provision was included to provide budget certainty to school districts facing a funding cliff or significant changes to their federally connected student enrollment.[3]

ESSA requires the state identification, collection and reporting of military-connected students in Title I, Part A, Section 1011:

> "(ii) For all students and disaggregated by each subgroup of students described in subsection (b)(2)(B)(xi), homeless status, status as a child in foster care, and status as a student with a parent who is a member of the Armed Forces (as defined in section 101(a)(4) of title 10, United States Code) on active duty (as defined in section 101(d)(5) of such title), information on student achievement on the academic assessments described in subsection (b)(2) at each level of achievement, as determined by the State under subsection (b)(1).[4]

This federal requirement will provide more consistent, easily identifiable data regarding military-connected students with a parent on active duty. As student identification improves, additional supports may be put into place to assist students who live with perpetual challenges presented by frequent moves, parental and sibling deployments, and transitions that include reintegration and dealing with profoundly changed parents. The well-being of these children depends heavily

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[3] National Conference of State Legislatures, "Summary of Every Student Succeeds Act, Legislation Reauthorizing the Elementary and Secondary Education Act." May be accessed at: http://www.ncsl.org/documents/capitolforum/2015/onlineresources/summary_12_10.pdf.
[4] Every Student Succeeds Act. More information may be accessed at: https://www2.ed.gov/policy/elsec/leg/essa/index.html.

on a network of supportive adults who are trained to identify early signs of emotional or physical challenge.

SC Collection of Military-Connected Student Data

ESSA requires the identification and collection of military-connected student data. South Carolina has an established mechanism for collecting this information. The SC Department of Education (SCDE) manages PowerSchool, the student data information system that is provided to school districts. It is the primary source for student data and is often used for state and federal reporting requirements. Student level data are input, validated and maintained by local school districts. The data are then transferred (pushed from districts) electronically to the SCDE through the Enrich Data Collection Tool. In PowerSchool, a "Parent Military Status" field includes a list with seven possible student status options, as shown in Table 1.[5] This field remains unchanged since the 2015 EOC report on military-connected students. In the PowerSchool Data Collection Manual for January-February 2018, SCDE emphasizes "verifying all foster, homeless, migrant or military-connected student data accurately indicating their status. If any student meets the definition at any point during the school year, that student should be counted for the entire year."[6]

In response to ESSA, the SCDE provides more detailed academic performance data on military-connected students that can be disaggregated by gender, economic status, English learner status, disability status, gender, homeless status, gifted and talented status, and foster care status.

Data reported by SCDE regarding military-connected students are based on district entry of student information into this field. As noted earlier in this report, districts may also receive federal Impact Aid funding for students who have at least one parent who is federally connected.

The October 25, 2018 update to PowerSchool modified Parent Military Status. Now only students of active or full-time military parents should be coded. The choice set reflects this change. This field determines student's status for the "Military-connected" accountability subgroup in Table 1.[7]

[5] SC Department of Education, "PowerSchool Data Collection Manual, Fall 2016-17," p. 127. May be accessed at: http://www.ed.sc.gov/data/information-systems/power-school-administration/powerschool-manuals-for-s-c-pages/powerschool-data-collection-manual-2016-2017/.
[6] SC Department of Education, "PowerSchool Data Collection Manual, January-February 2018," p. 7. May be accessed at: https://ed.sc.gov/scdoe/assets/File/DataCollectionSched/SC_PS_Data%20Collection-Specific_Fields_Combo%202017-18%20Winter%20Final.pdf, p. 145.
[7] SC State Reporting Updates, Update dated October 25, 2018. Accessed at https://ed.sc.gov/data/information-systems/power-school/sc-state-reporting-updates/.

Table 1
Military-Connected Student Data Collected in PowerSchool

Values
(blank) – Neither Parent nor Guardian is serving in any military service.
01 - A Parent or Guardian is serving Full-time in the National Guard and is not currently deployed.
02 - A Parent or Guardian is serving Full-time in the Reserves and is not currently deployed.
03 - A Parent or Guardian is serving Full-time in the National Guard and is currently deployed.
04 - A Parent or Guardian is serving Full-time in the Reserves and is currently deployed.
05 - A Parent or Guardian is serving in the military on active duty and is not deployed.
06 - A Parent or Guardian is serving in the military on active duty and is currently deployed.

II. Demographics of Military-Connected Students

National, state, and local district collection of military-connected student data continues to be inconsistent. ESSA requires the disaggregation of student-level data, including military-connected students. When this requirement is fully implemented, data collection should become more consistent and accurate.

Number of Military-Connected Students

Data related to military-connected students are collected and reported by districts in PowerSchool. Table 2 below shows 2020 data provided by SC Department of Education in February 2020 (for 2018 through 2020 school years) and includes National Guard, Reserves, and active duty military personnel. About 70 percent of military-connected students have at least one guardian or parent who is on active duty or deployed. Approximately 1,992 military-connected students had at least one parent who was deployed in school year 2020, representing an increase of 360 students from 2019. An additional 151 military-connected students were reported to have a parent who was on active duty but died within the last year. Another 1,087 military-connected students have a parent who was on active duty and wounded in 2020. While this category is a small percentage of the total number of military-connected students, the number of military-connected students with a parent who was wounded in 2020, is 38 percent greater than in 2018.

There has been a significant improvement in district reporting of military-connected students since 2016-17. Families and educators continue assisting with the reporting of this data, so district and school staff can identify students who may need additional support services. Military-connected students live with perpetual challenges presented by frequent moves, parental and sibling deployments, and additional transitions that include reintegration and dealing with profoundly changed parents. The well-being of these children depends heavily on a network of supportive adults who are trained to identify early signs of emotional, physical, and academic challenges.

Table 2
Military-Connected Students,
by Parental Military Branch and Deployment Status, 2018-20 School Years

Military Connection	School Year 2018		School Year 2019		School Year 2020	
	Number	Percent	Number	Percent	Number	Percent
National Guard - Not Deployed	2,116	14.6 %	2631	15.93%	3,027	16.60%
Reserves - Not Deployed	1,784	12.34%	2075	12.56%	2308	12.66%
National Guard – Deployed	326	2.26%	506	3.06%	543	2.98%
Reserves – Deployed	227	1.57%	295	1.79%	368	2.02%

Military Connection	School Year 2018		School Year 2019		School Year 2020	
	Number	Percent	Number	Percent	Number	Percent
Active Duty Military - Not Deployed	8,530	59.01%	9,314	56.40%	9,672	53.04%
Active Duty Military – Deployed	997	6.90%	1,021	6.18%	1,081	5.93%
Active Duty Military - Deceased in last year	62	0.43%	82	.50 %	151	.83%
Active Duty Military - Wounded in last year	414	2.86%	591	3.58%	1,087	5.96%
Subtotal Active Duty	**10,003**		**11,008**		**11,992**	
Total	**14,456**		**16,515**		**18,237**	

Source: SC Department of Education, data reported to EOC.

Of the 18,237 military-connected students reported by school districts to SCDE, approximately 81 percent of the students attend one of the eleven school districts listed in Table 3.

The Charleston Air Force Base and the Naval Weapons Station in Goose Creek comprise Joint Base Charleston (JB CHS). The installation covers almost 24,000 acres, and includes: three seaports, two civilian-military airfields, 39 miles of rail, and 22 miles of coastline. The Charleston Air Force Base Houses C-17 aircraft, and is home to the 437th Air Base Wing, the 628th Air Base Wing, and the 315th Air Wing. The Naval Weapons Station houses several programs, including the Navy's Nuclear Power Training Program, the Naval Information Warfare Center (NIWC) Atlantic, and several other tenant commands. The Naval Health Clinic, and the Air Force Military Treatment Facility, provide many medical services for military members and their families. The base is host to more than 60 Department of Defense and Federal agencies and is associated with approximately 50,000 jobs. The installation provides $3.6 billion in labor income, and an economic impact of $8.7 billion per year.

Both the Marine Corps Air Station Beaufort and Marine Corps Recruit Depot Parris Island/Eastern Recruiting Region are in Beaufort County. Marine Corps Air Station Beaufort, home of the Marine Corps' Atlantic Coast fixed-wing, fighter-attack aircraft assets, is in the heart of the South Carolina Lowcountry and is among the United States military's most important and most historically colorful installations. Consisting of some 7,000 acres 70 miles southwest of Charleston, South Carolina on Highway 21, the installation is home to five Marine Corps F/A- 18 squadrons and one F-35B Fleet Replacement Squadron. Two versions of the F/A-18 Hornet are found aboard MCAS Beaufort, the F/A-18C Hornet and the F/A-18D Hornet. The F-35B squadron is also the only location in the world where pilots train to fly the F-35B. The squadron also trains the United

Kingdom's future F-35B pilots and maintainers. The Marine Corps Recruit Depot is located on Parris Island and is one of the most visited military facilities in the world, hosting more than 120,000 guests each year. It is the headquarters of the Eastern Recruiting Region and for recruit training for all females and males east of the Mississippi River.

Fort Jackson and Shaw Air Force Base are in the Midlands. Located in Richland County, Fort Jackson is the Army's main production center for Basic Combat Training. Approximately 50 percent of the Army's Basic Combat Training is completed at Fort Jackson, with more than 48,000 basic training and 12,000 additional advanced training Soldiers every year. Fort Jackson is home to the U.S. Army Soldier Support Institute, the Armed Forces Army Chaplaincy Center and School, the National Center for Credibility Assessment (formerly the Department of Defense Polygraph Institute, and the Drill Sergeant School, which trains all Active Duty and Reserve instructors.

Shaw Air Force Base in Sumter County is home to Air Force's largest combat F-16 wing, the 20th Fighter Wing. Shaw also serves as home to Headquarters Ninth Air Force, U.S. Air Forces Central, Third Army, U.S. Army Central and many other tenant units.[8]

Table 3
Districts with Highest Military-Connected Student Populations, School Years 2018-19 and 2019-2020

School Year 2018-19			School Year 2019-20		
District	**Students**	**Percent**	**District**	**Students**	**Percent**
Richland 2	4,101	24.83	Richland 2	4,060	22.26
Dorchester 2	1,521	9.21	Horry	2,285	12.52
Horry	1,575	11.22	Dorchester 2	2,032	11.14
Beaufort	1,360	8.23	Beaufort	1,386	7.59
Berkeley	1,075	6.51	Berkeley	1,173	6.43
Lexington 1	1,041	6.30	Lexington 1	1,091	5.98
Sumter	846	5.12	Sumter	796	4.36
Kershaw	693	4.20	Kershaw	764	4.18
Lexington 5	570	3.45	Aiken	610	3.34
SC Public Charter School District	371	2.25	Lexington/Richland 5	568	3.11
Aiken	409	1.47	Anderson 1	357	1.95
Total	**12,705**	**82.65**	**Total**	**15,122**	**82.91**

Source: SC Department of Education, data reported to EOC.

[8] Information regarding South Carolina's military installations gathered from military installation websites and school liaison officers.

III. Student Performance

This section provides academic and attendance data for military-connected students for school year 2019-20 including:

- student achievement as measured by the Kindergarten Readiness Assessment (KRA)
- student achievement as measured by the End-Of-Course Examination Program (EOCEP)
- student achievement as measured by Advanced Placement Examinations
- student achievement on Career Ready Certification Areas
- high school graduation rates; and
- student attendance.

Academic Data

The end-of-year academic achievement of students, including MCS, in South Carolina was not available for 2019-20 due to COVID-19 school closures. This includes students in third through eighth grades on SC READY for English language arts (ELA) and mathematics and SC PASS for science for students in grades 4, 6 and 8. Statewide student performance on the Kindergarten Readiness Assessment (KRA), the South Carolina End-of-Course Evaluation Program (EOCEP) during the fall 2019 semester, Advanced Placement Examinations, and Career Readiness certifications and credentials are provided in this report.

Student Performance on Kindergarten Readiness Assessment (KRA)

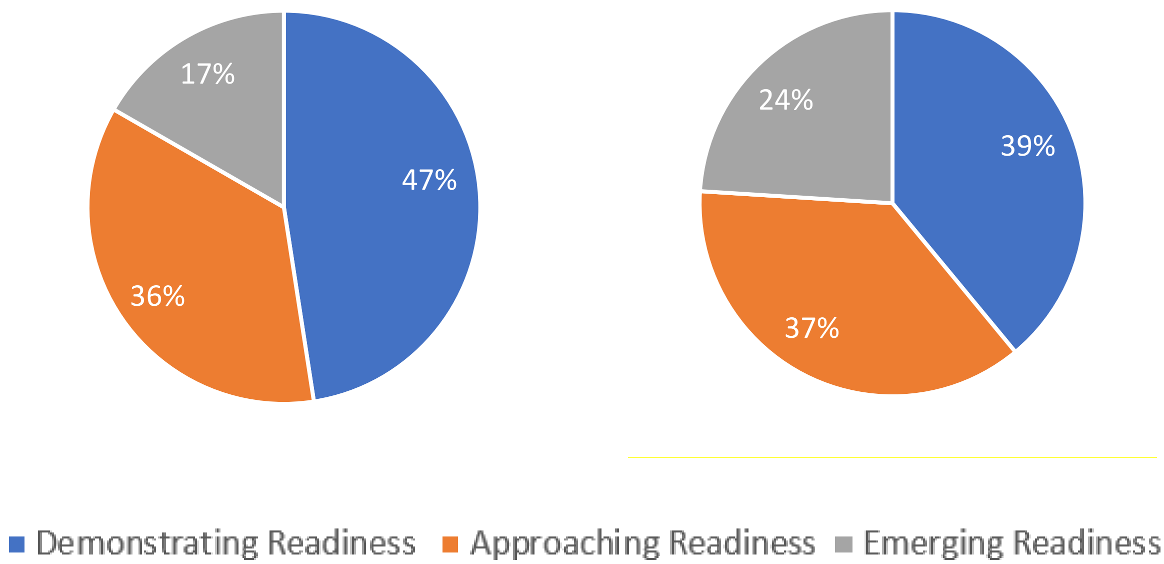
The EOC analyzed student performance in school year 2019-20 of all students enrolled in publicly funded kindergartens S.C. Code § 59-155-150 . The KRA is a developmentally appropriate instrument that measures a child's school readiness across multiple domains. KRA determines each child's readiness level from an evaluation of four domains: Social Foundations, Language/Literacy, Mathematics, and Physical Well-Being. According to the SCDE website, the KRA provides a snapshot of students' abilities at the beginning of the school year. Understanding a child's school readiness helps kindergarten teachers best meet the child's needs, and it helps schools, families, communities, and policymakers.

Scores from the 2019 KRA administration showed that 31 districts met or surpassed the overall state average (39%) for Demonstrating Readiness. The percentage of MCS students demonstrating readiness in 2019 was 47.5% (Table 4).

Figure 1

2020 KRA Performance of Military-Connected Students (MCS)

2020 KRA Performance of All SC students



Student Achievement in Grades Three through Eight (Suspended by Act 142)

The South Carolina College-and Career-Ready Assessments (SC READY) are statewide assessments in English language arts (ELA) and mathematics that measure the academic performance of students in grades 3-8. The South Carolina Palmetto Assessment of State Standards (SCPASS) is a statewide assessment administered in science to students in grades 4 and 6. Administration of both SC READY and SCPASS were suspended in the 2019-20 school year due to school closures.

South Carolina End-of-Course Examination Program (EOCEP)

The End-of-Course Examination Program (EOCEP) is a statewide assessment program of end-of-course tests for gateway courses awarded units of credit in English/language arts, mathematics, science, and social studies. The EOCEP encourages instruction in the specific standards for the courses, encourages student achievement, and documents the level of students' mastery of the academic standards. EOCEP examination scores count 20 percent in the calculation of the student's final grade in gateway courses, although the use of grades in the calculation of student grades was suspended for the 2020-21 school year. Defined gateway courses currently include Algebra 1, Intermediate Algebra, Biology 1, English 1, English 2, and United States History and the Constitution, or courses with other names and activity codes in which the academic standards corresponding to these subjects are taught.

To meet federal accountability requirements, the EOCEP in English/language arts, mathematics, and science must be administered to all public school students, including those students as required by the federal Individuals with Disabilities Education Improvement Act (IDEA) and by Title 1 of the Elementary and Secondary Education Act (ESEA). The English 1 EOCEP was not administered in school year 2019-20 school year; this course is year-long, and the exam could not be administered in the Spring.

To receive a South Carolina high school diploma, students are required to pass a high school credit course in science, and a high school credit course in United States history in which the state's end of course examinations are administered. Currently these courses are Biology 1 (science) and United States History and the Constitution (social studies). End-of-Course Examination Program (EOCEP) - South Carolina Department of Education (sc.gov)

Table 4 shows the of MCS performance on end-of-course exams. During the 2019-20 school year, military-connected students continued to outperform all students statewide on the End-of-Course Examination Program (EOCEP) exams in Algebra 1, Biology, and United States History. On average, military-connected students' mean scores for the three courses tested were 6.2 points higher.

Table 4
South Carolina End-of-Course Examination Program (EOCEP)

Academic Year	Military-Connected Students			All SC Students	
	Number of MCS	Mean Score	Letter Grade	Mean Score	Letter Grade
Algebra 1					
2015	668	85.7	B	82.6	C
2016	857	85.2	B	81.9	C
2017	1,000	72.2	C	69.4	D
2018	1,043	71.9	C	68.2	D
2019	841	72.4	C	69.8	D
2020	**179**	**69.1**	**D**	**63.7**	**D**
English 1*					
2015	636	83.6	C	79.4	C
2016	827	83.7	C	79.8	C
2017	1,024	75.9	C	71.4	C
2018	994	78.1	C	74.1	C
2019	724	77.5	C	74.6	C
Biology					
2013	310	84.2	C	78.1	C
2014	451	85.4	B	79.2	C
2015	580	86.5	B	82.3	B
2016	795	86.9	C	81.6	C
2017	943	81.5	C	75.3	C
2018	921	72.8	C	69.2	D
2019	NA**	NA	NA	NA	NA
2020	**406**	**72.2**	**C**	**67.9**	**D**
U.S. History and the Constitution					
2020	**317**	**69.05**	**C**	**67.6**	**D**

*2020: No results for English 1: year-long classes, and EOCEP given in Spring
**2019 results for Biology EOCEP were not reported to the EOC.

Advanced Placement Course Performance

Advanced Placement is a program in the United States and Canada created by the College Board which offers college-level courses and examinations to high school students. American colleges and universities may grant placement and course credit to students who obtain high scores on the examinations. Advanced Placement classes give students an opportunity to take college-level courses and exams while still in high school. Students enjoy the challenge of taking Advanced Placement courses with enthusiastic classmates and teachers; high school faculty find that Advanced Placement courses enhance their students' confidence and academic interest as well as their school's reputation; and college faculty report that Advanced Placement students are far better prepared for serious academic work. South Carolina state regulations require teachers of Advanced Placement courses to be endorsed to teach the courses . www.ed.sc.gov/instruction/standards-learning/advanced-academic-programs/advanced-placement/

Table 5
Advanced Placement (AP) Course Examination Performance of Military-Connected Students (MCS) with Active Duty Parents and All Students in South Carolina
2019-20 Passing Rates AP Courses with Highest Number of Tests

	Course Title	Number of Tests	Percentage Passing: Military-connected students	Percentage Passing All Students in SC
1	Human Geography	298	67%	59%
2	*English Language & Composition	242	62%	63%
3	U. S. History	215	60%	58%
4	Psychology	121	58%	65%
5	*English Literature & Composition	108	53%	61%
6	European History	105	56%	51%
7	World History	99	65%	62%
8	*Biology	77	57%	71%
9	*Calculus AB*	63	57%	78%
10	U. S. Government	56	38%	61%

*English, Science or Mathematics courses *Table shows the percentages

A total of 560 Advanced Placement Examinations were taken by Military-Connected Students (MCS) in grades 10,11 and 12 during the 2019-20 school year. MCS high school juniors (11) took the most exams (217) with seniors taking (193). Table 5 provides information on Advanced Placement courses (10) with the highest number of AP tests taken and passage rates for those courses. In school year 2019-20, Human Geography was the AP course with the highest number of tests administered and passing percentage (67 percent). For 9 of the 10 courses in the chart, MCS passing rates were above 52 percent. The passage rates for *English, Math, and science

AP courses ranged from 61.9 to 52.7 percent. MCS students had higher AP percentage passing for rates for Human Geography and U.S. History.

Career and Technology Education Certification

The Strengthening Career and Technical Education for the 21st Century Act (Perkins V) was signed into law on July 31, 2018, citing a mission that all students will achieve challenging academic and technical standards and be prepared for high-skill, high-wage, or high-demand occupations in current or emerging professions. The Act also provides an increased focus on the academic achievement of Career and Technical Education (CTE) students, an emphasis on improving State and local accountability, and strengthens the connections between secondary and postsecondary education. Technical skill assessments are tools that can be used to improve and prepare students to enter the workplace by demonstrating career readiness.

Table 6
MCS Top Career and Technology Certification/Credential Areas

Area of Certification/Credential	Number of Military-Connected Students	Number of High Schools/Career Centers Represented Statewide
OSHA10	77	34
Health Providers Basic Life Support (BLS)	69	8
Micro Burst EMPLOYABILITY Soft Skills Certification	55	20
OSHA 10-Healthcare-On line Modules	24	4
Digital Literacy	21	15
ServSafe® Food Handler	20	6

Table 6 includes a listing of certifications or credentials with the largest number of MCS students receiving them and the number of programs they represented statewide in 2019-20. These certifications/credentials are currently accepted as career readiness measures in the accountability system.

High School Graduation Rate

The federally approved on-time graduation rate identifies a cohort of students who were ninth grade students in a specific year and calculates the percentage of that cohort that graduates four years later. Students are removed from the cohort when they transfer to other degree-granting institutions or programs. Students who transfer into a district are added to the cohort.

Available data identifies students by grade level and graduation status. For students who were identified as being in twelfth grade during the 2019-120 timeframe, the EOC evaluation team could identify: (1) those students who graduated, (2) those who received a certificate or did not graduate, and (3) those students who transferred to other degree-granting institutions and were removed from the graduation cohort. Based on this information, the graduation rates for military-connected students are included below. Table 7 shows during the 2019-20 school year, the high school graduation rate for all military-connected students was 90.75 percent up from 86.9 in 2019. The state on-time graduation rate was 82.01 percent, slightly higher than 2019 (81.05).

Table 7
2019 and 2020 High School Graduation Rates for Military-Connected Students (MCS) and State Avg.

Year	Total Number of MCS	MCS Graduate Avg.	State Avg.
2019	868	86.9	81.1
2020	942	90.8	82.0

Source: SC Department of Education, March 2020 data reported to EOC.
https://www.screportcards.com/files/2020//data-files/

Attendance Data

[9]Student attendance rate is defined as the number of students present (as opposed to enrolled in) a school during the time it is in session, were computed using information provided by the South Carolina Department of Education. The attendance data for the 2019-20 school year was impacted by school closures due to COVID; for that reason, caution is urged when interpreting these data.

During the 2019-20 school year, the average number of days absent for military-connected students was 3.7 days. Table 8 shows the average number of days absent in South Carolina school districts with at least 30 military-connected students. Thirteen of these districts reported that military-connected students were absent for more than 3.7 school days. In 2019-20, York 3 and Chesterfield had the highest average absence rate (4.3 days), and Lexington 2 and

[9] For more information, refer to Military Child Education Coalition's "Military-Connected Students and Public-School Attendance Policies." May be accessed at http://www.militarychild.org/public/upload/files/SchoolAttendancePoliciesFINAL.pdf.

Spartanburg 2 had the lowest absence rate of 0 days. Districts in **bold** exceeded the average of 3.7 days absent in this grouping.

Table 8
Average Number of Days Absent in School Districts with at least 30 Military-Connected Students (MCS), 2019-20 School Year

District	Number of MCS	Average Number of Days Absent
Colleton	39	3.7
Chesterfield	275	4.3
Dillon 4	54	2.4
Aiken	609	3.6
Horry	2,285	3.1
Spartanburg 7	88	4.2
Darlington	314	3.7
Edgefield	80	3.8
York 1	45	3.2
Greenville	135	3.5
Kershaw	763	3.4
Oconee	154	3.6
Anderson 1	357	3.6
Charleston	355	2.9
Lexington 1	1,091	4.2
Sumter	795	3.9
York 3	221	4.3
Lexington 5	567	4
Richland 2	4,058	3.2
Spartanburg 2	104	0
Berkeley	1,171	3.3
Dorchester 2	2,032	3.8
Lancaster	142	2.7
Georgetown	160	2.8
Beaufort	1,386	3.6
Florence 1	186	3.8
Hampton	46	4.2
SC Public Charter School	281	2.4
Florence 2	33	.6
York 1	45	3.6
Pickens	137	4.0
Charter Institute at Erskine	45	0.2
Lexington 2	77	0

Note: Statewide attendance data not sent to EOC prior to report publication.

During the 2019-20 school year, the average number of days absent among all schools was 3.7 days, representing a 1.5 percent decrease from the 2018-19 school year average of 5.2 days. Table 9 lists nine school districts with military-connected students exceeding the average number of days absent among all school districts listed reported more days absent than the MCS 3.7 days absent average. The average number of days absent among military students remained constant at 4.7 days in 2018-19. Chesterfield and York 3 had the highest number of average days absent for military-connected students (4.3 days), in 2019-20.

Table 9
School Districts with at least 30 Military-Connected Students (MCS), Exceeding Average Number of Days Absent Among All SC Districts)

District	Number of MCS	Average Number of Days Absent
Chesterfield	275	4.3
York 3	221	4.3
Spartanburg 7	88	4.2
Lexington1	1091	4.2
Hampton	46	4.2
Pickens	137	4.0
Sumter	795	3.9
Edgefield	80	3.8
Dorchester 2	2032	3.8

Appendix A
Resources for Military-Connected Students and Families

Military Child Education Coalition (MCEC)

During the 2019-20 school year, the South Carolina Military Child Education Coalition (MCEC) was relocated to the Division of Veterans Affairs and Department of Commerce (budget).

In 2019, the Military Child Education Coalition (MCEC) updated and revised its portfolio to include additional course offerings, professional offerings, and support to military-connected families. This past year, MCEC trainers presented 80 courses to over 1500 professionals with an extended reach impact on nearly 21,000 adults. Support was continued to over 25,000 military-connected students, their parents, and education professionals across 20 school districts nationwide. Affiliates saw encouraging expansion in 2019, extending across Alabama, Texas, Virginia, Florida, and South Carolina.

South Carolina School Support Resources

School liaison officers continue to provide support and guidance about workshop content and family enrichment offerings to Military-connected families.

School Liaison Officers serve as a primary point of contact for students and their families transitioning to new communities and schools. They are also a resource for schools and school districts. To view a list of school liaison officers by branch, go to: https://www.dodea.edu/Partnership/schoolLiaisonOfficers.cfm.

Fort Jackson School Liaisons provide ongoing educational support for military-connected schools. This comprehensive website provides information about public and private schools, homeschooling, and local school districts.

https://jackson.armymwr.com/programs/school-liaison-officer

https://www.facebook.com/Jackson-CYS-School-Liaison-Officer-152018352105106/

Shaw Air Force Base is home to the 20th Fighter Wing, Headquarters Nine Air Force/United States Central Command of Air Forces, and several associate units. Shaw's units are assigned to Air Combat Command, Langley Air Force Base, Virginia. School Liaison information may be found at the website below.

https://www.shaw.af.mil/About-Us/Newcomer-Information/

Marine Corps Air Station and the Marine Corps Recruit Depot are in Beaufort. School support information may be accessed at the website below.

http://www.mccs-sc.com/mil-fam/slp.shtml

Joint Base Charleston School information may be accessed under the "Charleston Area Schools" link at:

https://www.jbcharleston.jb.mil/About-Us/Library/Newcomers

South Carolina Program Resources

The **International Baccalaureate** Program helps students develop skills to create a better and peaceful world through intercultural understanding and respect. For more information, including a list of South Carolina schools participating in the IB Program, go to https://www.ed.sc.gov/instruction/standards-learning/advanced-academic-programs/international-baccalaureate-programs-ib/.

Four-year-old kindergarten is available in the state and is offered in public schools and private childcare centers. State-funded prekindergarten for four-year-olds serves children in the "most at-risk" category, where family income falls 185% below poverty level or the family is Medicaid eligible. Families may also be eligible for other services such as Even Start, Head Start, state-funded family literacy programs, Social Security, food stamps, Medicaid, or temporary assistance to needy families (TANF).

Children also qualify in case of a documented developmental delay, an Individual Education Plan (IEP) requiring pre-kindergarten, incarceration of a parent, placement in a foster home, or a child who is homeless. Documentation of family or child "most at-risk" conditions must be kept on file for review. Children who participate in free and reduced meal programs at the center/school they attend may also qualify if income eligibility is verified on each child and records are kept on file for review.

Some districts use local funds to serve children who are not in the "at risk" category. Several districts serve all children who request services. A few districts charge a fee for non-qualifying children, but state regulations prohibit any fees for "at risk" children.

State law says that "students may enter kindergarten in the public schools of this State if they will attain the age of four on or before September first of the applicable school year."

https://www.ed.sc.gov/instruction/early-learning-and-literacy/cerdep/

National Resources

Department of Defense Education Activity provides professional development training in a webinar format for school liaison officers. This information is also helpful for local school districts to understand the needs of students and how to support them in a comprehensive manner.

https://www.dodea.edu/

Military Impacted School Association is a national organization of school superintendents. MISA supports school districts with a high concentration of military children by providing detailed, comprehensive information regarding impact aid and resources for families and schools.

http://militaryimpactedschoolsassociation.org/

The **Military Interstate Children's Compact Commission (MIC3)** provides consistent policy in every school district and in every state that voluntarily joins MIC3. MIC3 addresses key educational transition issues such as enrollment, placement, attendance, eligibility, and graduation.

http://www.mic3.net

The **Military Child Education Coalition (MCEC)** focuses on ensuring quality educational opportunities for all military children affected by mobility, family separation, and transition. A 501(c)(3) non-profit, world-wide organization, the MCEC performs research, develops resources, conducts professional institutes, and conferences, and develops and publishes resources for all constituencies.

http://www.militarychild.org/

Military OneSource is a confidential Department of Defense-funded program providing comprehensive information on every aspect of military life at no cost to active duty, National Guard, and reserve members, and their families.

Information includes, but is not limited to, deployment, reunion, relationships, grief, spouse employment and education, parenting, and childhood services. It is a virtual extension to installation services.

The program also provides free resources to schools, including books and videos with relevant topics that help students cope with divorce and deployment.

www.militaryonesource.mil

National Military Family Association (NMFA) a voice for military families advocating on behalf of service members, their spouses, and their children. According to NMFA's website, NMFA is the "go to" source for Administration Officials, Members of Congress, and key decision makers when they want to understand the issues facing military families.

https://www.militaryfamily.org/

South Carolina Military-connected Student Support

All states, including South Carolina, have joined the Interstate Compact regarding Educational Opportunity for Military Children to ease the transition for students and to ensure that there are no barriers to educational success imposed on children of military families because of frequent moves and deployment of their parents. Former Governor Mark Sanford signed the Compact on June 11, 2010 and it became law in South Carolina on July 1, 2010. For a list of the Compact member states, please visit the Military Interstate Children's Compact Commission (MIC3).

As a member of the Interstate Commission, South Carolina has a seat at the table to discuss with other member states the Articles of the Compact and identify best practices to ensure the educational issues associated with military families during their transitions are successfully addressed.

Council Members

Yolande Anderson State Chair, Education Dept. Appointee
LTC Felix Childs Governor appointee
Wanda Davis Military Family Education Liaison
Sen Paul Campbell State Senator
Sen Darrell Jackson State Senator Rep
. Robert Brown ,State Representative Rep.
Joseph Daning ,State Representative
Dr. Baron Davis Richland Two Superintendent
Dr. Sharon Wall St. Board of Education
Beth Shwedo Military Family Member LTC
Clarence Bowser SC National Guard
Charlie Farrell Military Installations Representative
Sheila J Spouse Representative of CG at Fort Jackson

School Liaison Officers

Sharon Gardner Charleston AFB
John F. Kennedy Shaw AFB
Kimberly Wiley MCAS Beaufort/Parris Island
James E. Harris, Jr. SC National Guard
Tina Paulson Marine Corp.
Chris Gerry USAF

https://ed.sc.gov/newsroom/military-interstate-children-s-compact-commission/sc-mic3-council-members/

Appendix B: Number of Military-Connected Students Reported by Districts, February 2020

District Name	Military-Connected Student Enrollment	District Name	Military-Connected Student Enrollment	District Name	Military-Connected Student Enrollment
Richland 2	4060	Edgefield	80	Anderson 04	6
Horry	2285	Lexington 2	77	Fairfield 01	5
Dorchester 2	2032	Dillon 4	54	Richland 01	5
Beaufort	1386	Hampton	46	Saluda 01	5
Berkeley	1173	Charter Institute at Erskine	45	Williamsburg 01	5
Lexington 1	1091	York 1	45	York 02	4
Sumter	796	Lancaster	41	Spartanburg 01	3
Kershaw	764	Colleton	39	Anderson 02	2
Aiken 01	610	Florence 2	33	Barnwell 29	2
Lexington 5	568	Florence 3	27	Spartanburg 05	2
Anderson 1	357	Anderson 3	26	Abbeville 60	1
Charleston	355	Clarendon 2	22	Bamberg 01	1

Darlington	314	Newberry	16	Barnwell 45	1
SC Public Charter School District	281	Orangeburg	16	Chester 01	1
Chesterfield	275	Lexington 4	15	Clarendon 03	1
York 3	221	Cherokee	12	Deaf & Blind School	1
Florence 1	186	Greenwood 50	12	Laurens 55	1
Georgetown	160	Laurens 56	9	Lexington 03	1
Oconee	154	Spartanburg 3	9	Marion 10	1
Pickens	137	Union	9	Marlboro 01	1
Greenville	135	McCormick	8	Spartanburg 04	1
Spartanburg 2	104	York 04	**7**	Spartanburg 06	1
Spartanburg 7	88	Allendale 01	6		

EDUCATION OVERSIGHT COMMITTEE

SUBCOMMITTEE: Academic Standards and Assessments

DATE: May 17, 2021

ACTION ITEM: Results of the 2020 Parent Survey

PURPOSE/AUTHORITY

Section 59-28-190 of the Parental Involvement in Their Children's Education Act requires the Education Oversight Committee (EOC) to "survey parents to determine if state and local efforts are effective in increasing parental involvement." In addition, Section 59-18-900 of the Education Accountability Act (EAA) requires that the annual school report cards include "evaluations of the school by parents, teachers, and students" as performance indicators to evaluate schools. The tool that has been adopted by the EOC and administered by the South Carolina Department of Education (SCDE) to meet these statutory requirements is the annual parent survey.

CRITICAL FACTS

The parent survey was commissioned by the EOC and designed by the Institute for Families in Society at the University of South Carolina in 2001. The survey is designed to determine parent perceptions of their child's school and to evaluate the effectiveness of state and local parental involvement programs. Since 2002 the South Carolina Department of Education has annually administered the survey, and the EOC has provided an annual review of the survey results. Although no survey was administered in the Spring of 2020, the report describes changes to the survey and to the delivery of the survey for Spring 2021.

TIMELINE/REVIEW PROCESS

The analysis was conducted in April and May of 2021.

ECONOMIC IMPACT FOR EOC

Cost: No fiscal impact beyond current appropriations

Fund/Source:

ACTION REQUEST

☒ **For approval** ☐ **For information**

ACTION TAKEN

☐ **Approved** ☐ **Amended**
☐ **Not Approved** ☐ **Action deferred (explain)**

2021

PARENT SURVEY

Annual Report for 2020

SC EDUCATION
OVERSIGHT COMMITTEE

PO Box 11867 | 227 Blatt Building | Columbia SC 29211 | WWW.SCEOC.ORG

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Acknowledgements

The Education Oversight Committee (EOC) acknowledges the ongoing assistance of Cynthia Hearn of the South Carolina Department of Education (SCDE) in providing important information on the annual administration of the parent survey.

Executive Summary

<u>Background:</u> The parent survey was designed in 2001 to meet the requirements of the Education Accountability Act (EAA) and the Parental Involvement in Their Children's Education Act. Section 59-18-900 of the EAA requires that the annual school report card include "evaluations of the school by parents, teachers, and students" as performance indicators to evaluate schools. In addition, Section 59-28-190 of the Parental Involvement in Their Children's Education Act requires the Education Oversight Committee (EOC) to "survey parents to determine if state and local efforts are effective in increasing parental involvement." The tool that has been adopted by the EOC and administered by the South Carolina Department of Education (SCDE) to meet these statutory requirements is the annual parent survey.

Since 2002 the SCDE has administered the parent survey to a sample of parents whose children attended public schools in South Carolina. From its inception, the parent survey contains items regarding parent perceptions of the learning environment in the school, home and school relations, and the social and physical environment of the school.

Two major changes are to occur in the Parent Survey for the Spring, 2021 administration. First, the survey will be administered using electronic devices, including smart phones. This change in administration methodology may change which parents are able and willing to respond to the survey. In prior years the survey was administered to select grades, with this change parents of students in all grade levels can respond to the survey. One possible drawback to the new administration methodology is that there is currently only one form of the survey; is parents may respond to the same survey multiple years, which may create response fatigue and less attentiveness to the survey.

Second, the survey has been revised, with two sections regarding parent participation reduced from 13 items to 1 section with 5 items. Two additional sections were deleted, one that obtained information about impediments to parent participation, and a second with four questions that were addressed elsewhere in the survey.

Administration of the 2020 Parent Survey

Schools in South Carolina were closed on March 16, 2020. As a result, the parent survey was not distributed in the Spring of 2020.

Administration of the 2021 Parent Survey

For the first time, in the Spring of 2021, the parent survey will be administered using electronic devices, including smart phones. Parents may access the survey using a personal computer with internet access or using their smart-phone. With these changes, the survey will now be made available to parents of students at all grade levels[1].

Another benefit of moving to electronic presentation is that content changes, as have been described, can be made more easily. The current Parent Survey included in Appendix C is the form of the survey as of March 11, 2021.

For all administrations through Spring, 2019, the parent survey was administered in printed form, distributed to parents through their child at school. Rather than surveying all parents of public school students, the parents of students in the highest grade at all elementary, middle and high schools were surveyed. In high schools and career centers, parents of all 11th graders were surveyed. In schools with a grade configuration that spans multiple levels, parents of children in multiple grades were surveyed. For example, in a school with a grade span of grades 6 through 10, parents of children in grades 8 and 10 were surveyed. For parents in schools with a grade span of K-12, parents of children in grades 5, 8 and 11 were surveyed. Parents in schools containing grades 2 or lower, which include primary schools, child development schools and schools with configurations like K, K-1, and K-2 were not surveyed

In prior years, the "typical" parent responding to the survey was a white female having attended or graduated from college. With respect to the ethnicity of children in the public schools of South Carolina in 2018-19, parents whose children are African American were underrepresented by 5.1 percent, and parents whose children are Hispanic were underrepresented by 1.5 percent in the respondents, while parents whose children are white were overrepresented by 8.1 percent.

With respect to educational attainment, 40.1 percent of parents who responded to the survey in 2019 had earned a bachelor or postgraduate degree. For comparison purposes, the United States Census Bureau reported that from 2013-2018, 27.0 percent of persons 25 years old and over in South Carolina had earned a bachelor's degree or higher[2].

Regarding the annual household income of the respondents, 65 percent of the parents who completed the survey in 2019 reported having an annual household income of $35,000 or more. For comparison purposes, according to the U.S. Census Bureau, the median household income in South Carolina from 2013-2018 was $48,781[3].

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[1] Communication from South Carolina Department of Education to EOC staff.

[2] U.S. Census Bureau, "State and County Quick Facts" <https://www.census.gov/quickfacts/fact/table/US/RHI125216#viewtop>, accessed April 27, 2019.

[3] Ibid.

Going forward, the number of responses by district and school will be obtained and compared to the number of students enrolled in each school to determine the response rates whether some schools' responses from the 2019 survey. There were 61,245 parent responses to the 2019 survey, which was 31 percent of the surveys distributed and 38 percent of the number of students in grades 5, 8, and 11, which were the grades surveys were most frequently distributed to. How the number of responses by district, school, and grade level for 2021 reflects the population of students enrolled in each school will be investigated for the annual report of the 2021 Parent Survey.

Changes to the Survey

State level parental feedback to SCDE staff over a number of years has been that the survey is too long. Summaries of the responses to many of the survey questions have demonstrated remarkable consistency as well. Based on these two circumstances, a decision was made to revise the parent survey for the 2020 administration. A summary of the changes to the survey is in Appendix A, a copy of the 2019 survey is in Appendix B, and a copy of the survey for Spring, 2021 as of March 11, 2021 is in Appendix C.

The changes to the survey are summarized here, with a tabular presentation of the differences between the prior and revised survey presented in Table 1.

No changes were made to the Learning Environment section of the survey, it contains the same 5 items as in the prior survey. The Home-School Relations section originally contained 11 items: two items were rewritten, and one item was deleted. The Social and Physical Environment section originally contained seven items; one item was rewritten, and one item deleted.

The largest changes to the survey were made to two sections of the survey that asked about parent involvement. These two sections contained eight and five items, respectively, and have been combined into one section that contains six items. The responses to these items have also changed. In the prior survey parents indicated whether they participated, and if they did not participate, whether they did not care to participate. The updated survey simply asks whether parents participated or not, because parental intent did not prove to be helpful for characterizing parent participation.

Three items that ask about student Individualized Graduation Plans (IGPs) have not been changed, and three items that ask about whether a student has been bullied also remain intact.

Two sections have been completely deleted. One section (seven questions) asked about the impediments to parental involvement, and the other asked four questions about school friendliness and communication with parents, three of which are addressed elsewhere in the survey.

Finally, the prior survey asked four questions about the parent's child: grade level, gender, race/ethnicity, and grades in school. The question regarding the child's grades in school has been deleted. Four questions regarding the parent remain: gender, race/ethnicity, level of education, and income.

Conclusions

1) The content changes will make the survey shorter for parents.
2) Eliminating the item format with responses that ask about parent desires will make summarization and interpretation of results simpler.
3) Ensuring that a sufficient number of parents from each school respond to the survey is important, especially in economically disadvantaged locations.
4) Changing the administration to electronic media provides greater flexibility in updating the survey.
5) Administering the same survey to all parents each year may be problematic. Response fatigue may result, and parents may either choose not to respond, or may respond with less fidelity to the survey.

Recommendations

1) For the next two years, a close analysis of parental response rate will be important. Whether some schools have very low response rates is very important to determine.
2) Examination of parent fidelity of respond may also be important. If observed, possible solutions are: 1) development of two forms to be administered in alternating years or to alternating grades, or 2) selecting grades to administer the survey to, similar to the hard copy process.

Appendix A. Parent Survey Changes - 2019 to 2020

Learning Environment No Changes Responses are: Strongly Agree – Agree – Disagree – Strongly Disagree – Don't Know
My child's teachers give homework that helps my child learn.
My child's school has high expectations for student learning.
My child's teachers encourage my child to learn.
My child's teachers provide extra help when my child needs it.
I am satisfied with the learning environment at my child's school.

Change	**Home-School Relations 2 Items Rewritten – 1 Item Deleted Responses are: Strongly Agree – Agree – Disagree – Strongly Disagree – Don't Know**	
	My child's teachers contact me to say good things about my child.	
	My child's teachers tell me how I can help my child learn.	
Rewritten	My child's teachers invite me to visit my child's classrooms during the school day.	I feel welcomed at my child's school.
Rewritten	My child's school returns my phone calls or e-mails promptly.	My child's school responds promptly when I have concerns.
Deleted	My child's school includes me in decision-making.	
	My child's school give me information about what my child should be learning in school.	
	My child's school considers changes based on what parents say.	
	My child's school schedules activities at time that I can attend.	
	My child's school treats all students fairly.	
	The principal at my child's school is available and welcoming.	
	I am satisfied with home-school relations at my child's school.	

Change	Social and Physical Environment 1 Item Rewritten – 1 Item Deleted Responses are: Strongly Agree – Agree – Disagree – Strongly Disagree – Don't Know	
	My child's school is kept clean.	
Rewritten	My child's teachers care about my child as an individual.	My child's teachers care about my child.
Deleted	Students at my child's school are well-behaved.	
	My child feels safe at school.	
	My child's teachers and school staff prevent or stop bullying at school.	
	My child's school has an anti-bullying program to prevent or deal with bullying.	
	I am satisfied with the social and physical environment at my child's school.	

Parent Involvement Responses for 2021: Yes – No Colors Identify Items that Address Similar Concepts	
2019 Parent Survey	**2021 Parent Survey**
Attend Open Houses or parent-teacher conferences.	I receive timely communication from my child's school (such as telephone calls, newsletters, emails, etc.).
Attend student programs or performances.	I receive regular updates of my child's educational progress.
Volunteer (bake cookies, help in office, help with school fundraising, etc.).	I attend school events such as open houses, parent-teacher conferences, and parent workshops.
Go on trips with my child's school (out-of-town band context, field trips, etc.).	I participate in school committees or organizations such as the PTA, PTO, or School Improvement Council.
Participate in School Improvement Council meetings.	I volunteer at my child's school.
Participate in Parent-Teacher-Student Organizations (PTA, PTO, etc.).	I help my child with school assignments when needed.

Participate in school committees (textbook committee, spring carnival committee, etc.).	
Attend parent workshops (how to help my child with school work, how to talk to my child about drugs, effective discipline, etc.)	
Visit my child's classrooms during the school day.	
Contact my child's teachers about my child's school work.	
Limit the amount of time my child watches TV, plays video games, surfs the internet, etc.	
Make sure my child does his/her homework.	
Help my child with homework when he/she needs it.	

Individualized Graduation Plan (IGP) **No Changes** **Responses are: Strongly Agree – Agree – Disagree – Strongly Disagree – Don't Know**
The IGP conference was beneficial to my child as he/she prepares to be promoted to the next grade level.
During the IGP conference, the counselors discussed my child's academic progress and his/her career goals.
I recommend that all parents/guardians attend IGP conferences with their children.

Bullying - No Changes
Has your child been bullied at school this year? (Yes/No)
If yes, where was your child bullied (6 options))
If yes, was your child bullied: Physically? Verbally? Both?

Change	**Student Questions** **1 Item Deleted**
	What grade is your child in?
	What is your child's gender?
	What is your child's race/ethnicity? (6 options)
Deleted	What grades did your child receive on his/her last report card? (4 options)

Parent Questions **No Changes**
What is your gender?
What is your race/ethnicity? (6 options – same as student)
What is the highest level of education you have completed? (4 categories)
What is your family's total yearly household income? (6 categories)

The following two sections were omitted

Please mark if each of the following is TRUE or FALSE
Lack of transportation reduces my involvement.
Family health problems reduce my involvement.
Lack of available card for my children or other family members reduces my involvement.
My work schedule makes it hard for me to be involved.
The school does not encourage my involvement.
Information about how to be involved either comes too late or not at all.
I don't feel like it is appreciated when I try to be involved.

Please rate your school on: Responses are: Very Good – Good – Okay – Bad – Very Bad
The school's overall friendliness.
The school's interest in parents' ideas and opinions.
The school's efforts to get important information from parents.
The school's efforts to give important information to parents.

APPENDIX B

The 2019 Parent Survey

South Carolina **Parent Survey**

School ID

School Name: [SCHOOL NAME]

Parents in South Carolina who have children in selected grades are being asked to complete this survey. This survey asks you how you feel about your child's school. Since this survey will be used to help make your child's school a better place, it is very important to tell us exactly what you think. Your answers will be kept private. The school will get a summary of the survey results.

Directions: Read each statement. Decide if you agree, mostly agree, mostly disagree or disagree with the statement. Then darken the bubble beside each statement. Do not write your name or address on this survey.

MARKING INSTRUCTIONS

- **Use a No. 2 pencil only.**
- **Do not use ink, ball point, or felt tip pens.**
- **Make solid marks that fill the circle completely.**

CORRECT ● INCORRECT

Learning Environment	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
1. My child's teachers give homework that helps my child learn.					
2. My child's school has high expectations for student learning.					
3. My child's teachers encourage my child to learn.					
4. My child's teachers provide extra help when my child needs it.					
5. I am satisfied with the learning environment at my child's school.					
Home-School Relations					
1. My child's teachers contact me to say good things about my child.					
2. My child's teachers tell me how I can help my child learn.					
3. My child's teachers invite me to visit my child's classrooms during the school day.					
4. My child's school returns my phone calls or e-mails promptly.					
5. My child's school includes me in decision-making.					
6. My child's school gives me information about what my child should be learning in school.					
7. My child's school considers changes based on what parents say.					
8. My child's school schedules activities at times that I can attend.					
9. My child's school treats all students fairly.					
10. The principal at my child's school is available and welcoming.					
11. I am satisfied with home-school relations at my child's school.					
Social and Physical Environment					
1. My child's school is kept neat and clean.					
2. My child's teachers care about my child as an individual.					
3. Students at my child's school are well-behaved.					
4. My child feels safe at school.					
5. My child's teachers and school staff prevent or stop bullying at school.					
6. My child's school has an anti-bullying program to prevent or deal with bullying.					
7. I am satisfied with the social and physical environment at my child's school.					

In accordance with the Education and Economic Development Act of 2005, school counseling personnel are required to invite parents/guardians of students in grades eight through twelve to participate in an annual conference with their sons or daughters to develop and/or review their individual graduation plans (IGP). During the IGP conferences, counselors should discuss a series of topics, including students' grades and academic progress, career assessments and goals, and upcoming courses. If your child is in eighth grade or high school, please respond to the following questions:

	Strongly Disagree	Disagree	Agree	Strongly Agree	Not Applicable
1. The IGP conference was beneficial to my child as he/she prepares to be promoted to the next grade level.					
2. During the IGP conference, the counselors discussed my child's academic progress and his/her career goals.					
3. I recommend that all parents/guardians attend IGP conferences with their children.					

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APPENDIX B

The 2019 Parent Survey

Please tell us if you do the following:	I do this	I don't do this, but I would like to	I don't do this, and I don't care to	The school does not offer this activity/event
1. Attend Open Houses or parent-teacher conferences	○	○	○	○
2. Attend student programs or performances.	○	○	○	○
3. Volunteer (bake cookies, help in office, help with school fundraising, etc.).	○	○	○	○
4. Go on trips with my child's school (out-of-town band contest, field trips, etc.).	○	○	○	○
5. Participate in School Improvement Council meetings.	○	○	○	○
6. Participate in Parent-Teacher-Student Organizations (PTA, PTO, etc.).	○	○	○	○
7. Participate in school committees (textbook committee, spring carnival committee, etc.).	○	○	○	○
8. Attend parent workshops (how to help my child with school work, how to talk to my child about drugs, effective discipline, etc.).	○	○	○	○

Please tell us if you do the following:	I do this	I don't do this, but I would like to	I don't do this, and I don't care to
1. Visit my child's classrooms during the school day.	○	○	○
2. Contact my child's teachers about my child's school work.	○	○	○
3. Limit the amount of time my child watches TV, plays video games, surfs the Internet, etc.	○	○	○
4. Make sure my child does his/her homework.	○	○	○
5. Help my child with homework when he/she needs it.	○	○	○

Please mark if each of the following is TRUE or FALSE.	True	False
1. Lack of transportation reduces my involvement.	○	○
2. Family health problems reduce my involvement.	○	○
3. Lack of available care for my children or other family members reduces my involvement.	○	○
4. My work schedule makes it hard for me to be involved.	○	○
5. The school does not encourage my involvement.	○	○
6. Information about how to be involved either comes too late or not at all.	○	○
7. I don't feel like it is appreciated when I try to be involved.	○	○

Please rate your school on:	Very Good	Good	Okay	Bad	Very Bad
1. The school's overall friendliness.	○	○	○	○	○
2. The school's interest in parents' ideas and opinions.	○	○	○	○	○
3. The school's efforts to get important information from parents.	○	○	○	○	○
4. The school's efforts to give important information to parents.	○	○	○	○	○

Please answer the following questions about your child:

1. What grade is your child in? ○ 3rd ○ 4th ○ 5th ○ 6th ○ 7th ○ 8th ○ 9th ○ 10th ○ 11th
2. What is your child's gender? ○ Male ○ Female
3. What is your child's race/ethnicity? ○ African-American/Black ○ Hispanic ○ Asian American/Pacific Islander ○ Caucasian/White ○ Native American ○ Other
4. What grades did your child receive on his/her last report card? ○ All or mostly A's and B's ○ All or mostly C's and D's ○ All or mostly B's and C's ○ All or mostly D's and F's

Bullying means a gesture, electronic communication, or written, verbal, physical, or sexual act that is reasonably perceived to have the effect of harming a student physically or emotionally or damaging a student's property or placing a student in reasonable fear of personal harm or property damage or insulting or demeaning a student.

5. Has your child been bullied at school this year? ○ Yes ○ No ○ Don't know
6. If yes, was your child bullied: (Mark all that apply) ○ In classroom ○ Other location at school ○ At sporting events ○ On-line/texting during school ○ On the bus ○ After school
7. If yes, was your child bullied: (Mark all that apply) ○ Physically ○ Verbally ○ Both

Please answer the following questions about yourself. We are asking these questions because we want to be sure that schools are including all parents. For each question, please mark only one answer. Your answers will be kept private.

1. What is your gender? ○ Male ○ Female
2. What is your race/ethnic group? ○ African-American/Black ○ Hispanic ○ Asian American/Pacific Islander ○ Caucasian/White ○ Native American ○ Other
3. What is the highest level of education you have completed?
   ○ Attended elementary/high school ○ Earned Associate Degree ○ Earned college degree
   ○ Completed high school/GED ○ Attended college/training program ○ Postgraduate study and/or degree
4. What is your family's total yearly household income? ○ Less than $15,000 ○ $25,000–$34,999 ○ $55,000–$75,000 ○ $15,000–$24,999 ○ $35,000–$54,999 ○ More than $75,000

Thank you very much for completing this survey!

APPENDIX B

The 2019 Parent Survey

South Carolina Parent Survey

School ID   School Name: ___________________

Parents in South Carolina who have children in selected grades are being asked to complete this survey. This survey asks you how you feel about your child's school. Since this survey will be used to help make your child's school a better place, it is very important to tell us exactly what you think. Your answers will be kept private. The schools will get a summary of the survey results.

Directions: Read each statement. Decide if you strongly disagree, disagree, agree, or strongly agree with the statement. Then darken the bubble beside each statement. Do not write your name or your child's name on this survey.

MARKING INSTRUCTIONS

Learning Environment	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
My child's teachers give homework that helps my child learn.					
My child's school has high expectations for student learning.					
My child's teachers encourage my child to learn.					
My child's teachers provide extra help when my child needs it.					
I am satisfied with the learning environment at my child's school.					

Home-School Relations

My child's teachers contact me to say good things about my child.

My child's teachers tell me how I can help my child learn.

I feel welcomed at my child's school.

My child's school responds promptly when I have concerns.

My child's school gives me information about what my child should be learning in school.

My child's school considers changes based on what parents say.

My child's school schedules activities at times that I can attend.

My child's school treats my child fairly.

The principal at my child's school is available and welcoming.

I am satisfied with home-school relations at my child's school.

Social and Physical Environment

My child's school is kept clean.

My child's teachers care about my child

My child feels safe at school

My child's teachers and school staff prevent or stop bullying at school.

My child's school has an anti-bullying program to prevent or deal with bullying.

I am satisfied with the social and physical environment at my child's school.

In accordance with the Education and Economic Development Act of 2005, school counseling personnel ae required to invite parents/guardian of students in grades eight through twelve participate in an annual conference with their sons or daughters to development and/or review their individual graduation plans (IGP). During the IGP conferences, counselors should discuss a series of topics, including students' grades and academic progress, career assessments and goals, and upcoming courses.

***If your child is in eighth grade or high school, please respond to the following statements**:*

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
The IGP conference was beneficial to my child as he/she prepares to be promoted to the next grade level.					
During the IGP conference, the counselors discussed my child's academic progress and his/her career goals.					
I recommend that all parents/guardians attend IGP conferences with their children.					

Please mark YES or No to the following statements about your child's school.	YES	NO
I receive timely communication from my child's school (such as telephone calls, newsletters, emails, etc.)		
I receive regular updates of my child's educational progress.		
I attend school events such as open houses, parent-teacher conferences, and parent workshops.		
I participate in school committees or organizations such as the PTO, PTO, or School Improvement Council.		
I volunteer at my child's school.		
I help my child with school assignments when needed.		

APPENDIX B

The 2019 Parent Survey

Please answer the following questions about your child who attends this school.
(If more than one of your children attend this school provide responses for the older child.)

What grade is you child in? __3 __4 __5 __6 __7 __8 __9 __10 __11 __12

What is your child's gender? __Male __Female

What is your child's race/ethnicity? __African American/Black __Hispanic __Asian American/Pacific Islander
(Mark all that apply.) __Caucasian/White __Native American __Other

Bullying mean a gesture, electronic communication, or written, verbal, or sexual act that is reasonably perceived to have the effect of harming a student physically or emotionally or damaging a student's property or placing a student in reasonable fear of personal harm or property damage or insulting or demeaning student.

Has your child been bullied at school this year? __Yes __No __Don't know

If yes, was your child bullied: __ In classroom __Other location at school __At school sporting event
(Mark all that apply.) __ On-line/texting during school __On bus __ After school

If YES, was you child bullied: __ Physically __ Verbally __ Both

Please answer the following questions about yourself. We are asking these questions because we want to be sure that schools are including all parents. For each question, please mark only one answer. Your answers will be kept private.

What is your gender? __Male __Female

What is your race/ethnicity? __African American/Black __Hispanic __Asian American/Pacific Islander
__Caucasian/White __Native American __Other or more than one race

What is the highest level of education you have completed?

__Attended elementary/high school __Earned associate degree __Earned college degree

__Earned high school diploma or GED __Attended college or training program __Postgraduate study and or degree

What is your family's total yearly household income? __Less than $15,000 __$25,000-$34,999 __$55,000-$75,000

__$15,000-$24,999 __$35,000-$54,000 __More than $75,000

__I prefer not to answer