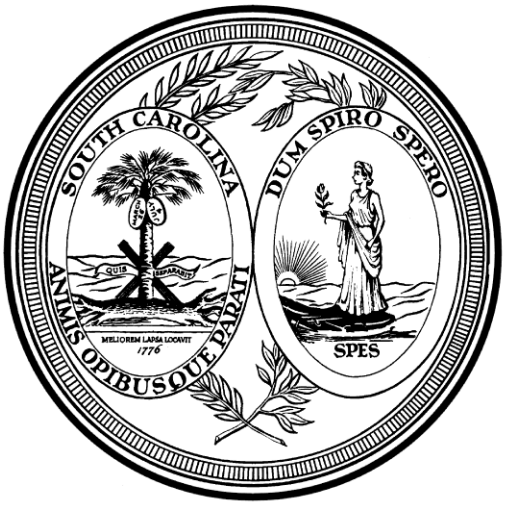
SOUTH CAROLINA
ACADEMIC STANDARDS AND PERFORMANCE INDICATORS FOR SCIENCE



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State Superintendent of Education

South Carolina Department of Education
Columbia, South Carolina

This document approved by Education Oversight Committee and State Board of Education

Contents

ACKNOWLEDGEMENTS

South Carolina owes a debt of gratitude to the following individuals for their assistance in the development of the *South Carolina Academic Standards and Performance Indicators for Science.*

SOUTH CAROLINA DEPARTMENT OF EDUCATION

The academic standards and performance indicators included in this document were revised under the direction of Charmeka Bosket Childs, Deputy Superintendent, Division of School Effectiveness, Dr. Briana Timmerman, Director, Office of Instructional Practices and Evaluations, and Cathy Jones Stork, Team Leader, Office of Instructional Practices and Evaluations.

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In addition, the SCDE extends special thanks to the following educators who gave their time, services and expertise to produce much of this document:

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Leann Iacuone (Lexington/Richland Five)
Kendrick Kerr (Lexington Two)
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Lori Smith (Sumter County)
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Karen Stratton (Retired Educator)
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The SCDE also wishes to thank staff from the Southwest Education Development Laboratory (SEDL) for their assistance with the revision of these standards:

Dr. Haidee Williams, Program Associate
Dr. Sandra Enger, Program Consultant

INTRODUCTION

Science is a way of understanding the physical universe using observation and experimentation to explain natural phenomena. Science also refers to an organized body of knowledge that includes core ideas to the disciplines and common themes that bridge the disciplines. This document, *South Carolina Academic Standards and Performance Indicators for Science*, contains the academic standards in science for the state's students in kindergarten through grade twelve.

ACADEMIC STANDARDS

In accordance with the South Carolina Education 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. Consensually developed academic standards describe for each grade and high school core area the specific areas of student learning that are considered the most important for proficiency in the discipline at the particular level.

Operating procedures for the review and revision of all South Carolina academic standards were jointly developed by staff at the State Department of Education (SCDE) and the Education Oversight Committee (EOC). According to these procedures, a field review of the first draft of the revised South Carolina science standards was conducted from March through May 2013. Feedback from that review and input from the SCDE and EOC review panels was considered and used to develop these standards.

The academic standards in this document are not sequenced for instruction and do not prescribe classroom activities; materials; or instructional strategies, approaches, or practices. The *South Carolina Academic Standards and Performance Indicators for Science* is not a curriculum.

STATEWIDE ASSESSMENT

The science standards and performance indicators for grades three through eight will be used as the basis for the development and/or refinement of questions on the South Carolina Palmetto Assessment of State Standards (SC-PASS) in science. The SC-PASS is based on the broad standards that address the life, earth, and physical science core content at each grade level. Test questions will measure the practice and/or the core content of the performance indicator. In addition, most performance indicators may be assessed with items that utilize any of the science and engineering practices. For example, an assessment item for a performance indicator that requires students to *construct explanations* may also ask students to use other practices such as *asking questions*, *using models*, or *analyzing data* around the core content in the original indicator. Items may also assess students' understanding of the core content without a science and engineering practice.

The high school course standards and performance indicators for Biology 1 will be used as the basis for the state-required End-of-Course Examination Program (EOCEP) for Biology 1.

SCIENCE CURRICULUM SUPPORT DOCUMENT

The SCDE will develop a support document after these standards have been adopted by the State Board of Education. Local districts, schools and teachers may use that document to construct standards-based science curriculum, allowing them to add or expand topics they feel are important and to organize content to fit their students' needs and match available instructional materials. The support document will include suggested resources, instructional strategies, essential knowledge, and assessment recommendations.

CROSSCUTTING CONCEPTS

Seven common threads or themes are presented in *A Framework for K-12 Science Education* (2012). These concepts connect knowledge across the science disciplines (biology, chemistry, physics, earth and space science) and have value to both scientists and engineers because they identify universal properties and processes found in all disciplines. These crosscutting concepts are:

1. Patterns
2. Cause and Effect: Mechanism and Explanation
3. Scale, Proportion, and Quantity
4. Systems and System Models
5. Energy and Matter: Flows, Cycles, and Conservation
6. Structure and Function
7. Stability and Change

These concepts should not to be taught in isolation but reinforced in the context of instruction within the core science content for each grade level or course.

SCIENCE AND ENGINEERING PRACTICES

In addition to the academic standards, each grade level or high school course explicitly identifies S*cience and Engineering Practice* standards, with indicators that are differentiated across grade levels and core areas. The term "practice" is used instead of the term "skill," to emphasize that scientists and engineers use skill and knowledge simultaneously, not in isolation. These eight science and engineering practices are:

1. Ask questions and define problems
2. Develop and use models
3. Plan and conduct investigations
4. Analyze and interpret data
5. Use mathematical and computational thinking
6. Construct explanations and design solutions
7. Engage in scientific argument from evidence
8. Obtain, evaluate, and communicate information

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade levels and courses. It is critical that educators understand that the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level or course.

Additionally, an important component of all scientists and engineers' work is communicating their results both by informal and formal speaking and listening, and formal reading and writing. Speaking, listening, reading and writing is important not only for the purpose of sharing results, but because during the processes of reading, speaking, listening and writing, scientists and engineers continue to construct their own knowledge and understanding of meaning and implications of their research. Knowing how one's results connect to previous results and what those connections reveal about the underlying principles is an important part of the scientific discovery process. Therefore, students should similarly be reading, writing, speaking and listening throughout the scientific processes in which they engage.

STRUCTURE OF THE STANDARDS DOCUMENT

The organization and structure of this standards document includes:

- **Grade Level Overview**: An overview that describes the specific content and themes for each grade level and/or high school course.

- **Academic Standard**: Statements of the most important, consensually determined expectations for student learning in a particular discipline. In South Carolina, academic standards are specified for kindergarten through grade eight and for the following high school courses: biology, chemistry, physics, and earth science.

- **Conceptual Understanding**: Statements of the core ideas for which students should demonstrate an understanding. Some grade level topics include more than one conceptual understanding with each building upon the intent of the standard.

- **Performance Indicator**: Statements of what students can do to demonstrate knowledge of the conceptual understanding. Each performance indicator includes a specific science and engineering practice paired with the content knowledge and skills that students should demonstrate to meet the grade level or high school course standards.

- The term *including* appears in parenthetical statements in the performance indicators. It is used to introduce a list of specified components for an indicator that are critical for a specific grade level or course with regard to the state assessments and the management of instructional time. Teachers should focus instruction on the entire indicator including the instructional components specified in the parenthetical statements. The phrase *such as* also appears in parenthetical statements in the performance indicators and provides potential examples to help frame, but not limit, the learning.

RESOURCES

The SCDE, in partnership with SEDL, developed the *Academic Standards and Performance Indicators for Science* utilizing a number of resources. Central among these resources were the *South Carolina Science Academic Standards 2005*. Other resources include:

American Association for the Advancement of Science, 2001. *Atlas of Science Literacy*. Washington, D.C.: Project 2061 and the National Science Teachers Association.

American Association for the Advancement of Science. 2009. *Benchmarks for Science Literacy.* Project 2061. Available at http://www.project2061.org/publications/bsl/online/index.php.

College Board. 2009. *Science College Board Standards for College Success*. Available at http://professionals.collegeboard.com/profdownload/cbscs-science-standards-2009.pdf.

Duschl, Richard A., Heidi A. Schweingruber, and Andrew W. Shouse. *Taking Science to School: Learning and Teaching Science in Grades K-8*. Washington, D.C.: National Academies, 2007.

Lerner, L.S., Goodenough, U., Lynch, J. Schwartz, M. and Schwartz, R. 2012. *The State of State Science Standards 2012*. Available at: http://www.edexcellence.net/publications/the-state-of-state-science-standards-2012.html.

Michaels, Sarah, Andrew W. Shouse, and Heidi A. Schweingruber. *Ready, Set, Science! Putting Research to Work in K-8 Science Classrooms*. Washington, D.C.: National Academies, 2008.

National Research Council. 2012. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, D.C.: National Academies Press.

National Assessment Governing Board. 2010. *Science Framework for the 2011 National Assessment of Educational Progress.* Washington, D.C.: U.S. Dept. of Education.

KINDERGARTEN OVERVIEW

In kindergarten through grade two, the standards and performance indicators for the science and engineering practices and core science content emphasize students making observations and explanations about phenomena they can directly explore and investigate. Student experiences should be structured as they begin to learn the features of a scientific investigation and engage in the practices of science and engineering. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of kindergarten.

The three core areas of the kindergarten standards include:

- Exploring Organisms and the Environment
- Exploring Weather Patterns
- Exploring Properties of Objects and Materials

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of learning experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for kindergarten should be the basis for the development of classroom and grade-level assessments. Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future learning in science.

KINDERGARTEN
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard K.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

K.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

K.S.1A.1 Ask and answer questions about the natural world using explorations, observations, or structured investigations.

K.S.1A.2 Develop and use models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

K.S.1A.3 With teacher guidance, conduct structured investigations to answer scientific questions, test predictions and develop explanations: (1) predict possible outcomes, (2) identify materials and follow procedures, (3) use appropriate tools or instruments to make qualitative observations and take nonstandard measurements, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

K.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

K.S.1A.5 Use mathematical thinking to (1) recognize and express quantitative observations, (2) collect and analyze data, or (3) understand patterns and relationships.

K.S.1A.6 Construct explanations of phenomena using (1) student-generated observations and measurements, (2) results of investigations, or (3) data communicated in graphs, tables, or diagrams.

K.S.1A.7 Construct scientific arguments to support explanations using evidence from observations or data collected.

K.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions about the natural world, (2) understand phenomena, (3) develop models, or (4) support explanations. Communicate observations and explanations using oral and written language.

K.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

K.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem, and (6) communicate the results.

KINDERGARTEN
LIFE SCIENCE: EXPLORING ORGANISMS AND THE ENVIRONMENT

Standard K.L.2: The student will demonstrate an understanding of organisms found in the environment and how these organisms depend on the environment to meet those needs.

K.L.2A. Conceptual Understanding: The environment consists of many types of organisms including plants, animals, and fungi. Organisms depend on the land, water, and air to live and grow. Plants need water and light to make their own food. Fungi and animals cannot make their own food and get energy from other sources. Animals (including humans) use different body parts to obtain food and other resources needed to grow and survive. Organisms live in areas where their needs for air, water, nutrients, and shelter are met.

Performance Indicators: Students who demonstrate this understanding can:

K.L.2A.1 Obtain information to answer questions about different organisms found in the environment (such as plants, animals, or fungi).

K.L.2A.2 Conduct structured investigations to determine what plants need to live and grow (including water and light).

K.L.2A.3 Develop and use models to exemplify how animals use their body parts to (1) obtain food and other resources, (2) protect themselves, and (3) move from place to place.

K.L.2A.4 Analyze and interpret data to describe how humans use their senses to learn about the world around them.

K.L.2A.5 Construct explanations from observations of what animals need to survive and grow (including air, water, nutrients, and shelter).

K.L.2A.6 Obtain and communicate information about the needs of organisms to explain why they live in particular areas.

KINDERGARTEN
EARTH SCIENCE: EXPLORING WEATHER PATTERNS

Standard K.E.3: The student will demonstrate an understanding of daily and seasonal weather patterns.

K.E.3A. Conceptual Understanding: Weather is a combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. Scientists measure weather conditions to describe and record the weather and to notice patterns over time. Plants and animals (including humans) respond to different weather conditions in different ways.

Performance Indicators: Students who demonstrate this understanding can:

K.E.3A.1 Analyze and interpret local weather condition data (including precipitation, wind, temperature, and cloud cover) to describe weather patterns that occur from day to day, using simple graphs and pictorial weather symbols.

K.E.3A.2 Develop and use models to predict seasonal weather patterns and changes.

K.E.3A.3 Obtain and communicate information to support claims about how changes in seasons affect plants and animals.

K.E.3A.4 Define problems caused by the effects of weather on human activities and design solutions or devices to solve the problem.

KINDERGARTEN
PHYSICAL SCIENCE: EXPLORING PROPERTIES OF OBJECTS AND MATERIALS

Standard K.P.4: The student will demonstrate an understanding of the observable properties of matter.

K.P.4A. Conceptual Understanding: Objects can be described and classified by their observable properties, by their uses, and by whether they occur naturally or are manufactured (human-made). Different properties of objects are suited for different purposes.

Performance Indicators: Students who demonstrate this understanding can:

K.P.4A.1 Analyze and interpret data to compare the qualitative properties of objects (such as size, shape, color, texture, weight, flexibility, attraction to magnets, or ability to sink or float) and classify objects based on similar properties.

K.P.4A.2 Develop and use models to describe and compare the properties of different materials (including wood, plastic, metal, cloth, and paper) and classify materials by their observable properties, by their uses, and by whether they are natural or human-made.

K.P.4A.3 Conduct structured investigations to answer questions about which materials have the properties that are best suited to solve a problem or need.

GRADE 1 OVERVIEW

In kindergarten through grade two, the standards and performance indicators for the science and engineering practices and core science content emphasize students making observations and explanations about phenomena they can directly explore and investigate. Student experiences should be structured as they begin to learn the features of a scientific investigation and engage in the practices of science and engineering. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade one.

The four core areas of the grade one standards include:

- Exploring Light and Shadows
- Exploring the Sun and Moon
- Earth's Natural Resources
- Plants and Their Environments

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for grade one should be the basis for the development of classroom and grade-level assessments. Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science learning.

GRADE ONE
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 1.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

1.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

1.S.1A.1 Ask and answer questions about the natural world using explorations, observations, or structured investigations.

1.S.1A.2 Develop and use models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

1.S.1A.3 With teacher guidance, conduct structured investigations to answer scientific questions, test predictions and develop explanations: (1) predict possible outcomes, (2) identify materials and follow procedures, (3) use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

1.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

1.S.1A.5 Use mathematical and computational thinking to (1) recognize and express quantitative observations, (2) collect and analyze data, or (3) understand patterns and relationships.

1.S.1A.6 Construct explanations of phenomena using (1) student-generated observations and measurements, (2) results of scientific investigations, or (3) data communicated in graphs, tables, or diagrams.

1.S.1A.7 Construct scientific arguments to support claims or explanations using evidence from observations or data collected.

1.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions about the natural world, (2) understand phenomena, (3) develop models, or (4) support explanations. Communicate observations and explanations clearly through oral and written language.

1.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

1.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem, and (6) communicate the results.

GRADE ONE
PHYSICAL SCIENCE: EXPLORING LIGHT AND SHADOWS

Standard 1.P.2: The student will demonstrate an understanding of the properties of light and how shadows are formed.

1.P.2A. Conceptual Understanding: Objects can only be seen when light shines on them. Some materials allow light to pass through them; others allow only some light to pass through; and some do not allow any light to pass through and will create a shadow of the object. Technology such as mirrors can change the direction of a beam of light.

Performance Indicators: Students who demonstrate this understanding can:

1.P.2A.1 Obtain and communicate information to describe how light is required to make objects visible.

1.P.2A.2 Analyze and interpret data from observations to compare how light behaves when it shines on different materials.

1.P.2A.3 Conduct structured investigations to answer questions about how shadows change when the position of the light source changes.

1.P.2A.4 Develop and use models to describe what happens when light shines on mirrors based on observations and data collected.

GRADE ONE
EARTH SCIENCE: EXPLORING THE SUN AND MOON

Standard 1.E.3: The student will demonstrate an understanding of the patterns of the Sun and the Moon and the Sun's effect on Earth.

1.E.3A. Conceptual Understanding: Objects in the sky move in predictable patterns. Some objects are better seen in the day sky and some are better seen in the night sky. The Sun is a star that provides heat and light energy for Earth.

Performance Indicators: Students who demonstrate this understanding can:

1.E.3A.1 Use, analyze, and interpret data from observations to describe and predict seasonal patterns of sunrise and sunset.

1.E.3A.2 Use data from personal observations to describe, predict, and develop models to exemplify how the appearance of the moon changes over time in a predictable pattern.

1.E.3A.3 Obtain and communicate information to describe how technology has enabled the study of the Sun, the Moon, planets, and stars.

1.E.3A.4 Conduct structured investigations to answer questions about the effect of sunlight on Earth's surface.

1.E.3A.5 Define problems related to the warming effect of sunlight and design possible solutions to reduce its impact on a particular area.

GRADE ONE
EARTH SCIENCE: EARTH'S NATURAL RESOURCES

Standard 1.E.4: The student will demonstrate an understanding of the properties and uses of Earth's natural resources.

1.E.4A. Conceptual Understanding: Earth is made of different materials, including rocks, sand, soil, and water. An Earth material is a resource that comes from Earth. Earth materials can be classified by their observable properties.

Performance Indicators: Students who demonstrate this understanding can:

1.E.4A.1 Analyze and interpret data from observations and measurements to compare the properties of Earth materials (including rocks, soils, sand, and water).

1.E.4A.2 Develop and use models (such as drawings or maps) to describe patterns in the distribution of land and water on Earth and classify bodies of water (including oceans, rivers and streams, lakes, and ponds).

1.E.4A.3 Conduct structured investigations to answer questions about how the movement of water can change the shape of the land.

1.E.4B. Conceptual Understanding: Natural resources are things that people use that come from Earth (such as land, water, air, and trees). Natural resources can be conserved.

Performance Indicators: Students who demonstrate this understanding can:

1.E.4B.1 Obtain and communicate information to summarize how natural resources are used in different ways (such as soil and water to grow plants; rocks to make roads, walls, or buildings; or sand to make glass).

1.E.4B.2 Obtain and communicate information to explain ways natural resources can be conserved (such as reducing trash through reuse, recycling, or replanting trees).

GRADE ONE
LIFE SCIENCE: PLANTS AND THEIR ENVIRONMENTS

Standard 1.L.5: The student will demonstrate an understanding of how the structures of plants help them survive and grow in their environments.

1.L.5A. Conceptual Understanding: Plants have specific structures that help them survive, grow, and produce more plants. Plants have predictable characteristics at different stages of development.

Performance Indicators: Students who demonstrate this understanding can:

1.L.5A.1 Obtain and communicate information to construct explanations for how different plant structures (including roots, stems, leaves, flowers, fruits, and seeds) help plants survive, grow, and produce more plants.

1.L.5A.2 Construct explanations of the stages of development of a flowering plant as it grows from a seed using observations and measurements.

1.L.5B. Conceptual Understanding: Plants have basic needs that provide energy in order to grow and be healthy. Each plant has a specific environment where it can thrive. There are distinct environments in the world that support different types of plants. These environments can change slowly or quickly. Plants respond to these changes in different ways.

Performance Indicators: Students who demonstrate this understanding can:

1.L.5B.1 Conduct structured investigations to answer questions about what plants need to live and grow (including air, water, sunlight, minerals, and space).

1.L.5B.2 Develop and use models to compare how the different characteristics of plants help them survive in distinct environments (including deserts, forests, and grasslands).

1.L.5B.3 Analyze and interpret data from observations to describe how changes in the environment cause plants to respond in different ways (such as turning leaves toward the Sun, leaves changing color, leaves wilting, or trees shedding leaves).

GRADE 2 OVERVIEW

In kindergarten through grade two, the standards and performance indicators for the science and engineering practices and core science content emphasize students making observations and explanations about phenomena they can directly explore and investigate. Student experiences should be structured as they begin to learn the features of a scientific investigation and engage in the practices of science and engineering. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade two.

The four core areas of the grade two standards include:

- Weather
- Properties of Solids and Liquids
- Exploring Pushes and Pulls
- Animals and Their Environments

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety experiences, materials, and instructional strategies that accommodate abroad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for grade two should be the basis for the development of classroom and grade-level assessments. Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science learning when students will be formally assessed at the state-level.

GRADE TWO
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 2.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

2.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

2.S.1A.1 Ask and answer questions about the natural world using explorations, observations, or structured investigations.

2.S.1A.2 Develop and use models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

2.S.1A.3 With teacher guidance, conduct structured investigations to answer scientific questions, test predictions and develop explanations: (1) predict possible outcomes, (2) identify materials and follow procedures, (3) use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

2.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

2.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate English or metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships.

2.S.1A.6 Construct explanations of phenomena using (1) student-generated observations and measurements, (2) results of scientific investigations, or (3) data communicated in graphs, tables, or diagrams.

2.S.1A.7 Construct scientific arguments to support claims or explanations using evidence from observations or data collected.

2.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions about the natural world, (2) understand phenomena, (3) develop models, or (4) support explanations. Communicate observations and explanations using oral and written language.

2.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

2.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem, and (6) communicate the results.

GRADE TWO
EARTH SCIENCE: WEATHER

Standard 2.E.2: The student will demonstrate an understanding of the daily and seasonal weather patterns.

2.E.2A. Conceptual Understanding: Weather is the combination of sunlight, wind, precipitation (rain, sleet, snow, and hail), and temperature in a particular region at a particular time. Scientists measure and record these conditions to describe the weather and to identify patterns over time. Weather scientists (meteorologists) forecast severe weather so that communities can prepare for and respond to these events.

Performance Indicators: Students who demonstrate this understanding can:

2.E.2A.1 Analyze and interpret data from observations and measurements to describe local weather conditions (including temperature, wind, and forms of precipitation).

2.E.2A.2 Analyze local weather data to predict daily and seasonal patterns over time.

2.E.2A.3 Develop and use models to describe and compare the effects of wind (moving air) on objects.

2.E.2A.4 Obtain and communicate information about severe weather conditions to explain why certain safety precautions are necessary.

GRADE TWO
PHYSICAL SCIENCE: PROPERTIES OF SOLIDS AND LIQUIDS

Standard 2.P.3: The student will demonstrate an understanding of the observable properties of solids and liquids and the special properties of magnets.

2.P.3A. Conceptual Understanding: Solids and liquids are two forms of matter that have distinct observable properties. Some matter can be mixed together and then separated again. Solids and liquids can be changed from one form to another when heat is added or removed.

Performance Indicators: Students who demonstrate this understanding can:

2.P.3A.1 Analyze and interpret data from observations and measurements to describe the properties used to classify matter as a solid or a liquid.

2.P.3A.2 Develop and use models to exemplify how matter can be mixed together and separated again based on the properties of the mixture.

2.P.3A.3 Conduct structured investigations to test how adding or removing heat can cause changes in solids and liquids.

2.P.3A.4 Construct scientific arguments using evidence from investigations to support claims that some changes in solids or liquids are reversible and some are not when heat is added or removed.

2.P.3B. Conceptual Understanding: Magnets are a specific type of solid that can attract and repel certain other kinds of materials, including other magnets. There are some materials that are neither attracted to nor repelled by magnets. Because of their special properties, magnets are used in various ways.

Performance Indicators: Students who demonstrate this understanding can:

2.P.3B.1 Conduct structured investigations to answer questions about how the poles of magnets attract and repel each other.

2.P.3B.2 Analyze and interpret data from observations to compare the effects of magnets on various materials.

2.P.3B.3 Obtain and communicate information to exemplify the uses of magnets in everyday life.

GRADE TWO
PHYSICAL SCIENCE: EXPLORING PUSHES AND PULLS

Standard 2.P.4: The student will demonstrate an understanding of the effects of pushes, pulls, and friction on the motion of objects.

2.P.4A. Conceptual Understanding: An object that is not moving will only move if it is pushed or pulled. Pushes and pulls can vary in strength and direction and can affect the motion of an object. Gravity is a pull that makes objects fall to the ground. Friction is produced when two objects come in contact with each other and can be reduced if needed.

Performance Indicators: Students who demonstrate this understanding can:

2.P.4A.1 Analyze and interpret data from observations and measurements to compare the effects of different strengths and directions of pushing and pulling on the motion of an object.

2.P.4A.2 Develop and use models to exemplify the effects of pushing and pulling on an object.

2.P.4A.3 Construct explanations of the relationship between the motion of an object and the pull of gravity using observations and data collected.

2.P.4A.4 Conduct structured investigations to answer questions about the relationship between friction and the motion of objects.

2.P.4A.5 Define problems related to the effects of friction and design possible solutions to reduce the effects on the motion of an object.

GRADE TWO
LIFE SCIENCE: ANIMALS AND THEIR ENVIRONMENTS

Standard 2.L.5: The student will demonstrate an understanding of how the structures of animals help them survive and grow in their environments.

2.L.5A. Conceptual Understanding: There are many different groups of animals. One way to group animals is by using their physical characteristics. Animals have basic needs that provide for energy, growth, reproduction, and protection. Animals have predictable characteristics at different stages of development.

Performance Indicators: Students who demonstrate this understanding can:

2.L.5A.1 Obtain and communicate information to classify animals (such as mammals, birds, amphibians, reptiles, fish, or insects) based on their physical characteristics.

2.L.5A.2 Construct explanations for how structures (including structures for seeing, hearing, grasping, protection, locomotion, and obtaining and using resources) of different animals help them survive.

2.L.5A.3 Construct explanations using observations and measurements of an animal as it grows and changes to describe the stages of development of the animal.

2.L.5B. Conceptual Understanding: Animals (including humans) require air, water, food, and shelter to survive in environments where these needs can be met. There are distinct environments in the world that support different types of animals. Environments can change slowly or quickly. Animals respond to these changes in different ways.

Performance Indicators: Students who demonstrate this understanding can:

2.L.5B.1 Obtain and communicate information to describe and compare how animals interact with other animals and plants in the environment.

2.L.5B.2 Develop and use models to exemplify characteristics of animals that help them survive in distinct environments (such as salt and freshwater, deserts, forests, wetlands, or polar lands).

2.L.5B.3 Analyze and interpret data from observations to describe how animals respond to changes in their environment (such as changes in food availability, water, or air).

2.L.5B.4 Construct scientific arguments to explain how animals can change their environments (such as the shape of the land or the flow of water).

GRADE 3 OVERVIEW

In grades three through five, the standards and performance indicators for the science and engineering practices and core science content emphasize students becoming more sophisticated in describing, representing or explaining concepts or ideas. Students use their experiences from structured investigations in kindergarten through grade two to begin planning their own investigations to answer scientific questions. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade three.

The four core areas of the grade three standards include:

- Properties and Changes in Matter
- Energy Transfer – Electricity and Magnetism
- Earth's Materials and Resources
- Environments and Habitats

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for grade three should be the basis for the development of classroom and grade-level assessments. In addition, these standards and performance indicators will be the basis for the development of items on the state-required South Carolina Palmetto Assessment of State Standards (SC-PASS). Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science learning.

GRADE THREE
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 3.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

3.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

3.S.1A.1 Ask questions that can be (1) answered using scientific investigations or (2) used to refine models, explanations, or designs.

3.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

3.S.1A.3 Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

3.S.1A.4 Analyze and interpret data from observations, measurements, or investigations to understand patterns and meanings.

3.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate English or metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships.

3.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

3.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

3.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.

3.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

3.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

GRADE THREE
PHYSICAL SCIENCE: PROPERTIES AND CHANGES IN MATTER

Standard 3.P.2: The student will demonstrate an understanding of the properties used to classify matter and how heat energy can change matter from one state to another.

3.P.2A. Conceptual Understanding: Matter exists in several different states and is classified based on observable and measurable properties. Matter can be changed from one state to another when heat (thermal energy) is added or removed.

Performance Indicators: Students who demonstrate this understanding can:

3.P.2A.1 Analyze and interpret data from observations and measurements to describe and compare the physical properties of matter (including length, mass, temperature, and volume of liquids).

3.P.2A.2 Construct explanations using observations and measurements to describe how matter can be classified as a solid, liquid or gas.

3.P.2A.3 Plan and conduct scientific investigations to determine how changes in heat (increase or decrease) change matter from one state to another (including melting, freezing, condensing, boiling, and evaporating).

3.P.2A.4 Obtain and communicate information to compare how different processes (including burning, friction, and electricity) serve as sources of heat energy.

3.P.2A.5 Define problems related to heat transfer and design devices or solutions that facilitate (conductor) or inhibit (insulator) the transfer of heat.

GRADE THREE
PHYSICAL SCIENCE: ENERGY TRANSFER – ELECTRICITY AND MAGNETISM

Standard 3.P.3: The student will demonstrate an understanding of how electricity transfers energy and how magnetism can result from electricity.

3.P.3A. Conceptual Understanding: Energy can be transferred from place to place by electric currents. Electric currents flowing through a simple circuit can be used to produce motion, sound, heat, or light. Some materials allow electricity to flow through a circuit and some do not.

Performance Indicators: Students who demonstrate this understanding can:

3.P.3A.1 Obtain and communicate information to develop models showing how electrical energy can be transformed into other forms of energy (including motion, sound, heat, or light).

3.P.3A.2 Develop and use models to describe the path of an electric current in a complete simple circuit as it accomplishes a task (such as lighting a bulb or making a sound).

3.P.3A.3 Analyze and interpret data from observations and investigations to classify different materials as either an insulator or conductor of electricity.

3.P.3B. Conceptual Understanding: Magnets can exert forces on other magnets or magnetizable materials causing energy transfer between them, even when the objects are not touching. An electromagnet is produced when an electric current passes through a coil of wire wrapped around an iron core. Magnets and electromagnets have unique properties.

Performance Indicators: Students who demonstrate this understanding can:

3.P.3B.1 Develop and use models to describe and compare the properties of magnets and electromagnets (including polarity, attraction, repulsion, and strength).

3.P.3B.2 Plan and conduct scientific investigations to determine the factors that affect the strength of an electromagnet.

GRADE THREE
EARTH SCIENCE: EARTH'S MATERIALS AND PROCESSES

Standard 3.E.4: The student will demonstrate an understanding of the composition of Earth and the processes that shape features of Earth's surface.

3.E.4A. Conceptual Understanding: Earth is made of materials (including rocks, minerals, soil, and water) that have distinct properties. These materials provide resources for human activities.

Performance Indicators: Students who demonstrate this understanding can:

3.E.4A.1 Analyze and interpret data from observations and measurements to describe and compare different Earth materials (including rocks, minerals, and soil) and classify each type of material based on its distinct physical properties.

3.E.4A.2 Develop and use models to describe and classify the pattern distribution of land and water features on Earth.

3.E.4A.3 Obtain and communicate information to exemplify how humans obtain, use, and protect renewable and nonrenewable Earth resources.

3.E.4B. Conceptual Understanding: Earth's surface has changed over time by natural processes and by human activities. Humans can take steps to reduce the impact of these changes.

Performance Indicators: Students who demonstrate this understanding can:

3.E.4B.1 Develop and use models to describe the characteristics of Earth's continental landforms and classify landforms as volcanoes, mountains, valleys, canyons, plains, and islands.

3.E.4B.2 Plan and conduct scientific investigations to determine how natural processes (including weathering, erosion, and gravity) shape Earth's surface.

3.E.4B.3 Obtain and communicate information to explain how natural events (such as fires, landslides, earthquakes, volcanic eruptions, or floods) and human activities (such as farming, mining, or building) impact the environment.

3.E.4B.4 Define problems caused by a natural event or human activity and design devices or solutions to reduce the impact on the environment.

GRADE THREE
LIFE SCIENCE: ENVIRONMENTS AND HABITATS

Standard 3.L.5: The student will demonstrate an understanding of how the characteristics and changes in environments and habitats affect the diversity of organisms.

3.L.5A. Conceptual Understanding: The characteristics of an environment (including physical characteristics, temperature, availability of resources, or the kinds and numbers of organisms present) influence the diversity of organisms that live there. Organisms can survive only in environments where their basic needs are met. All organisms need energy to live and grow. This energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy.

Performance Indicators: Students who demonstrate this understanding can:

3.L.5A.1 Analyze and interpret data about the characteristics of environments (including salt and fresh water, deserts, grasslands, forests, rain forests, and polar lands) to describe how the environment supports a variety of organisms.

3.L.5A.2 Develop and use a food chain model to classify organisms as producers, consumers, and decomposers and to describe how organisms obtain energy.

3.L.5B. Conceptual Understanding: When the environment or habitat changes, some plants and animals survive and reproduce, some move to new locations, and some die. Fossils can be used to infer characteristics of environments from long ago.

Performance Indicators: Students who demonstrate this understanding can:

3.L.5B.1 Obtain and communicate information to explain how changes in habitats (such as those that occur naturally or those caused by organisms) can be beneficial or harmful to the organisms that live there.

3.L.5B.2 Develop and use models to explain how changes in a habitat cause plants and animals to respond in different ways (such as hibernating, migrating, responding to light, death, or extinction).

3.L.5B.3 Construct scientific arguments using evidence from fossils of plants and animals that lived long ago to infer the characteristics of early environments.

GRADE 4 OVERVIEW

In grades three through five, the standards and performance indicators for the science and engineering practices and core science content emphasize students becoming more sophisticated in describing, representing or explaining concepts or ideas. Students use their experiences from structured investigations in kindergarten through grade two to begin planning their own investigations to answer scientific questions. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These academic standards and performance indicators establish the practices and core content for that South Carolina's students should know and be able to do by the end of grade four.

The four core areas of the grade four standards include:

- Weather and Climate
- Stars and the Solar System
- Forms of Energy – Light and Sound
- Characteristics and Growth of Organisms

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for grade four should be the basis for the development of classroom and grade-level assessments. In addition, these standards and performance indicators will be the basis for the development of items on the state-required South Carolina Palmetto Assessment of State Standards (SC-PASS). Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science learning.

GRADE FOUR
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 4.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

4.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

4.S.1A.1 Ask questions that can be (1) answered using scientific investigations or (2) used to refine models, explanations, or designs.

4.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

4.S.1A.3 Plan and conduct scientific investigations to answer questions, test predictions and develop explanations: (1) formulate scientific questions and predict possible outcomes, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

4.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.

4.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate English or metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.

4.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

4.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

4.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.

4.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

4.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

GRADE FOUR
EARTH SCIENCE: WEATHER AND CLIMATE

Standard 4.E.2: The student will demonstrate an understanding of the water cycle and weather and climate patterns.

4.E.2A. Conceptual Understanding: Earth's atmosphere is a mixture of gases, including water vapor and oxygen. The movement of water, which is found almost everywhere on Earth including the atmosphere, changes form and cycles between Earth's surface and the air and back again. This cycling of water is driven by energy from the Sun. The movement of water in the water cycle is a major pattern that influences weather conditions. Clouds form during this cycle and various types of precipitation result.

Performance Indicators: Students who demonstrate this understanding can:

4.E.2A.1 Obtain and communicate information about some of the gases in the atmosphere (including oxygen, nitrogen, and water vapor) to develop models that exemplify the composition of Earth's atmosphere where weather takes place.

4.E.2A.2 Develop and use models to explain how water changes as it moves between the atmosphere and Earth's surface during each phase of the water cycle (including evaporation, condensation, precipitation, and runoff).

4.E.2B. Conceptual Understanding: Scientists record patterns in weather conditions across time and place to make predictions about what kind of weather might occur next. Climate describes the range of an area's typical weather conditions and the extent to which those conditions vary over long periods of time. Some weather conditions lead to severe weather phenomena that have different effects and safety concerns.

Performance Indicators: Students who demonstrate this understanding can:

4.E.2B.1 Analyze and interpret data from observations, measurements, and weather maps to describe patterns in local weather conditions (including temperature, precipitation, wind speed/direction, relative humidity, and cloud types) and predict changes in weather over time.

4.E.2B.2 Obtain and communicate information about severe weather phenomena (including thunderstorms, hurricanes, and tornadoes) to explain steps humans can take to reduce the impact of severe weather phenomena.

4.E.2B.3 Construct explanations about regional climate differences using data from the long term weather conditions of the region**.**

GRADE FOUR
EARTH SCIENCE: STARS AND THE SOLAR SYSTEM

Standard 4.E.3: The student will demonstrate an understanding of the locations, movements, and patterns of stars and objects in the solar system.

4.E.3A. Conceptual Understanding: Astronomy is the study of objects in our solar system and beyond. A solar system includes a sun, (star), and all other objects that orbit that sun. Planets in our night sky change positions and are not always visible from Earth as they orbit our Sun. Stars that are beyond the solar system can be seen in the night sky in patterns called constellations. Constellations can be used for navigation and appear to move together across the sky because of Earth's rotation.

Performance Indicators: Students who demonstrate this understanding can:

4.E.3A.1 Develop and use models of Earth's solar system to exemplify the location and order of the planets as they orbit the Sun and the main composition (rock or gas) of the planets.

4.E.3A.2 Obtain and communicate information to describe how constellations (including Ursa Major, Ursa Minor, and Orion) appear to move from Earth's perspective throughout the seasons.

4.E.3A.3 Construct scientific arguments to support claims about the importance of astronomy in navigation and exploration (including the use of telescopes, astrolabes, compasses, and sextants).

4.E.3B. Conceptual Understanding: Earth orbits around the Sun and the Moon orbits around Earth. These movements together with the rotation of Earth on a tilted axis result in patterns that can be observed and predicted.

Performance Indicators: Students who demonstrate this understanding can:

4.E.3B.1 Analyze and interpret data from observations to describe patterns in the (1) location, (2) movement, and (3) appearance of the Moon throughout the year.

4.E.3B.2 Construct explanations of how day and night result from Earth's rotation on its axis.

4.E.3B.3 Construct explanations of how the Sun appears to move throughout the day using observations of shadows.

4.E.3B.4 Develop and use models to describe the factors (including tilt, revolution, and angle of sunlight) that result in Earth's seasonal changes.

GRADE FOUR
PHYSICAL SCIENCE: FORMS OF ENERGY – LIGHT AND SOUND

Standard 4.P.4: The student will demonstrate an understanding of the properties of light and sound as forms of energy.

4.P.4A. Conceptual Understanding: Light, as a form of energy, has specific properties including color and brightness. Light travels in a straight line until it strikes an object. The way light reacts when it strikes an object depends on the object's properties.

Performance Indicators: Students who demonstrate this understanding can:

4.P.4A.1 Construct scientific arguments to support the claim that white light is made up of different colors.

4.P.4A.2 Analyze and interpret data from observations and measurements to describe how the apparent brightness of light can vary as a result of the distance and intensity of the light source.

4.P.4A.3 Obtain and communicate information to explain how the visibility of an object is related to light.

4.P.4A.4 Develop and use models to describe how light travels and interacts when it strikes an object (including reflection, refraction, and absorption) using evidence from observations.

4.P.4A.5 Plan and conduct scientific investigations to explain how light behaves when it strikes transparent, translucent, and opaque materials.

4.P.4B. Conceptual Understanding: Sound, as a form of energy, is produced by vibrating objects and has specific properties including pitch and volume. Sound travels through air and other materials and is used to communicate information in various forms of technology.

Performance Indicators: Students who demonstrate this understanding can:

4.P.4B.1 Plan and conduct scientific investigations to test how different variables affect the properties of sound (including pitch and volume).

4.P.4B.2 Analyze and interpret data from observations and measurements to describe how changes in vibration affects the pitch and volume of sound.

4.P.4B.3 Define problems related to the communication of information over a distance and design devices or solutions that use sound to solve the problem.

GRADE FOUR
LIFE SCIENCE: CHARACTERISTICS AND GROWTH OF ORGANISMS

Standard 4.L.5: The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.

4.L.5A. Conceptual Understanding: Scientists have identified and classified many types of plants and animals. Each plant or animal has a unique pattern of growth and development called a life cycle. Some characteristics (traits) that organisms have are inherited and some result from interactions with the environment.

Performance Indicators: Students who demonstrate this understanding can:

4.L.5A.1 Obtain and communicate information about the characteristics of plants and animals to develop models which classify plants as flowering or nonflowering and animals as vertebrate or invertebrate.

4.L.5A.2 Analyze and interpret data from observations and measurements to compare the stages of development of different seed plants.

4.L.5A.3 Develop and use models to compare the stages of growth and development in various animals.

4.L.5A.4 Construct scientific arguments to support claims that some characteristics of organisms are inherited from parents and some are influenced by the environment.

4.L.5B. Conceptual Understanding: Plants and animals have physical characteristics that allow them to receive information from the environment. Structural adaptations within groups of plants and animals allow them to better survive and reproduce.

Performance Indicators: Students who demonstrate this understanding can:

4.L.5B.1 Develop and use models to compare how humans and other animals use their senses and sensory organs to detect and respond to signals from the environment.

4.L.5B.2 Construct explanations for how structural adaptations (such as the types of roots, stems, or leaves; color of flowers; or seed dispersal) allow plants to survive and reproduce.

4.L.5B.3 Construct explanations for how structural adaptations (such as methods for defense, locomotion, obtaining resources, or camouflage) allow animals to survive in the environment.

GRADE 5 OVERVIEW

In grades three through five, the standards and performance indicators for the science and engineering practices and core science content emphasize students becoming more sophisticated in describing, representing or explaining concepts or ideas. Students use their experiences from structured investigations in kindergarten through grade two to begin planning their own investigations to answer scientific questions. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade five.

The four core areas of the grade five standards include:

- Matter and Mixtures
- Changes in Landforms and Oceans
- Forces and Motion
- Interdependent Relationships in Ecosystems

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for grade five should be the basis for the development of classroom and grade-level assessments. In addition, these standards and performance indicators will be the basis for the development of items on the state-required South Carolina Palmetto Assessment of State Standards (SC-PASS). Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science learning.

GRADE FIVE
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 5.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

5.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

5.S.1A.1 Ask questions used to (1) generate hypotheses for scientific investigations or (2) refine models, explanations, or designs.

5.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

5.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

5.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

5.S.1A.5 Use mathematical and computational thinking to (1) express quantitative observations using appropriate metric units, (2) collect and analyze data, or (3) understand patterns, trends and relationships between variables.

5.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

5.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

5.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena, (3) develop models, or (4) support hypotheses, explanations, claims, or designs. Communicate observations and explanations using the conventions and expectations of oral and written language.

5.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

5.S.1B.1 Construct devices or design solutions to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the devices or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

GRADE FIVE
PHYSICAL SCIENCE: MATTER AND MIXTURES

Standard 5.P.2: The student will demonstrate an understanding of the physical properties of matter and mixtures.

5.P.2A. Conceptual Understanding: Matter is made up of particles that are too small to be seen. Even though the particles are very small, the movement and spacing of these particles determines the basic properties of matter.

Performance Indicators: Students who demonstrate this understanding can:

5.P.2A.1 Analyze and interpret data from observations and measurements of the physical properties of matter (including volume, shape, movement, and spacing of particles) to explain why matter can be classified as a solid, liquid or gas.

5.P.2B. Conceptual Understanding: A mixture is formed when two or more kinds of matter are put together. Sometimes when two or more different substances are mixed together, a new substance with different properties may be formed but the total amount (mass) of the substances is conserved. Solutions are a special type of mixture in which one substance is dissolved evenly into another substance. When the physical properties of the components in a mixture are not changed, they can be separated in different physical ways.

Performance Indicators: Students who demonstrate this understanding can:

5.P.2B.1 Obtain and communicate information to describe what happens to the properties of substances when two or more substances are mixed together.

5.P.2B.2 Analyze and interpret data to support claims that when two substances are mixed the total amount (mass) of the substances does not change.

5.P.2B.3 Develop models using observations to describe mixtures, including solutions, based on their characteristics.

5.P.2B.4 Construct explanations for how the amount of solute and the solvent determine the concentration of a solution.

5.P.2B.5 Conduct controlled scientific investigations to test how different variables (including temperature change, particle size, and stirring) affect the rate of dissolving.

5.P.2B.6 Design and test the appropriate method(s) (such as filtration, sifting, attraction to magnets, evaporation, chromatography, or floatation) for separating various mixtures.

GRADE FIVE
EARTH SCIENCE: CHANGES IN LANDFORMS AND OCEANS

Standard 5.E.3: The student will demonstrate an understanding of how natural processes and human activities affect the features of Earth's landforms and oceans.

5.E.3A. Conceptual Understanding: Some of the land on Earth is located above water and some is located below the oceans. The downhill movement of water as it flows to the ocean shapes the appearance of the land. There are patterns in the location and structure of landforms found on the continents and those found on the ocean floor.

Performance Indicators: Students who demonstrate this understanding can:

5.E.3A.1 Construct explanations of how different landforms and surface features result from the location and movement of water on Earth's surface through watersheds (drainage basins) and rivers.

5.E.3A.2 Develop and use models to describe and compare the characteristics and locations of the landforms on continents with those on the ocean floor (including the continental shelf and slope, the mid-ocean ridge, the rift zone, the trench, and the abyssal plain).

5.E.3B. Conceptual Understanding: Earth's oceans and landforms can be affected by natural processes in various ways. Humans cannot eliminate natural hazards caused by these processes but can take steps to reduce their impacts. Human activities can affect the land and oceans in positive and negative ways.

Performance Indicators: Students who demonstrate this understanding can:

5.E.3B.1 Analyze and interpret data to describe and predict how natural processes (such as weathering, erosion, deposition, earthquakes, tsunamis, hurricanes, or storms) affect Earth's surface.

5.E.3B.2 Develop and use models to explain the effect of the movement of ocean water (including waves, currents, and tides) on the ocean shore zone (including beaches, barrier islands, estuaries, and inlets).

5.E.3B.3 Construct scientific arguments to support claims that human activities (such as conservation efforts or pollution) affect the land and oceans of Earth.

5.E.3B.4 Define problems caused by natural processes or human activities and test possible solutions to reduce the impact on landforms and the ocean shore zone.

GRADE FIVE
LIFE SCIENCE: INTERDEPENDENT RELATIONSHIPS IN ECOSYSTEMS

Standard 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems.

5.L.4A. Conceptual Understanding: Ecosystems are complex, interactive systems that include both the living components (biotic factors) and physical components (abiotic factors) of the environment. Ecosystems can be classified as either terrestrial (such as forests, wetlands, and grasslands) or aquatic (such as oceans, estuaries, lakes, and ponds).

Performance Indicators: Students who demonstrate this understanding can:

5.L.4A.1 Analyze and interpret data to summarize the abiotic factors (including quantity of light and water, range of temperature, salinity, and soil composition) of different terrestrial ecosystems and aquatic ecosystems.

5.L.4A.2 Obtain and communicate information to describe and compare the biotic factors (including individual organisms, populations, and communities) of different terrestrial and aquatic ecosystems.

5.L.4B. Conceptual Understanding: All organisms need energy to live and grow. Energy is obtained from food. The role an organism serves in an ecosystem can be described by the way in which it gets its energy. Energy is transferred within an ecosystem as organisms produce, consume, or decompose food. A healthy ecosystem is one in which a diversity of life forms are able to meet their needs in a relatively stable web of life.

Performance Indicators: Students who demonstrate this understanding can:

5.L.4B.1 Analyze and interpret data to explain how organisms obtain their energy and classify an organisms as producers, consumers (including herbivore, carnivore, and omnivore), or decomposers (such as fungi and bacteria).

5.L.4B.2 Develop and use models of food chains and food webs to describe the flow of energy in an ecosystem.

5.L.4B.3 Construct explanations for how organisms interact with each other in an ecosystem (including predators and prey, and parasites and hosts).

5.L.4B.4 Construct scientific arguments to explain how limiting factors (including food, water, space, and shelter) or a newly introduced organism can affect an ecosystem.

GRADE FIVE
PHYSICAL SCIENCE: FORCES AND MOTION

Standard 5.P.5: The student will demonstrate an understanding of the factors that affect the motion of an object.

5.P.5A. Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.

Performance Indicators: Students who demonstrate this understanding can:

5.P.5A.1 Use mathematical and computational thinking to describe and predict the motion of an object (including position, direction, and speed).

5.P.5A.2 Develop and use models to explain how the amount or type of force (contact and non-contact) affects the motion of an object.

5.P.5A.3 Plan and conduct controlled scientific investigations to test the effects of balanced and unbalanced forces on the rate and direction of motion of objects.

5.P.5A.4 Analyze and interpret data to describe how a change of force, a change in mass, or friction affects the motion of an object.

5.P.5A.5 Design and test possible devices or solutions that reduce the effects of friction on the motion of an object.

GRADE 6 OVERVIEW

In grades six through eight, the standards and performance indicators for the science and engineering practices and core science content, transition students to developing and planning controlled investigations to create more explicit and detailed models and explanations. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom. Science in the middle school provides students with the foundation to be successful in high school science courses, by providing a range of content in the life, earth, and physical sciences.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade six.

The four core areas of the grade six standards include:

- Earth's Weather and Climate
- Energy Transfer and Conservation
- Diversity of Life – Classification and Animals
- Diversity of Life – Protists, Fungi, and Plants

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations

The academic standards and performance indicators for grade six should be the basis for the development of classroom and grade-level assessments. In addition, these standards and performance indicators will be the basis for the development of items on the state-required South Carolina Palmetto Assessment of State Standards (SC-PASS). Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science courses.

GRADE SIX

SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 6.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

6.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

6.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

6.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

6.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

6.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

6.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

6.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

6.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts**.**

6.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

6.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

6.S.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

GRADE SIX
EARTH SCIENCE: EARTH'S WEATHER AND CLIMATE

Standard 6.E.2: The student will demonstrate an understanding of the interactions within Earth's systems (flow of energy) that regulate weather and climate.

6.E.2A. Conceptual Understanding: Earth's atmosphere, an envelope of gases that surround the planet, makes conditions on Earth suitable for living things and influences weather. Water is always moving between the atmosphere (troposphere) and the surface of Earth as a result of the force of gravity and energy from the Sun. The Sun is the driving energy source for heating Earth and for the circulation of Earth's atmosphere.

Performance Indicators: Students who demonstrate this understanding can:

6.E.2A.1 Develop and use models to exemplify the properties of the atmosphere (including the gases, temperature and pressure differences, and altitude changes) and the relative scale in relation to the size of Earth.

6.E.2A.2 Critically analyze scientific arguments based on evidence for and against how different phenomena (natural and human induced) may contribute to the composition of Earth's atmosphere.

6.E.2A.3 Construct explanations of the processes involved in the cycling of water through Earth's systems (including transpiration, evaporation, condensation and crystallization, precipitation, and downhill flow of water on land).

6.E.2B. Conceptual Understanding: The complex patterns of changes and movement of water in the atmosphere determined by winds, landforms, ocean temperatures and currents, and convection are major determinants of local weather patterns and climate. Technology has enhanced our ability to measure and predict weather patterns.

Performance Indicators: Students who demonstrate this understanding can:

6.E.2B.1 Analyze and interpret data from weather conditions (including wind speed and direction, air temperature, humidity, cloud types, and air pressure), weather maps, satellites, and radar to predict local weather patterns and conditions.

6.E.2B.2 Develop and use models to explain how relationships between the movement and interactions of air masses, high and low pressure systems, and frontal boundaries result in weather conditions and storms (including thunderstorms, hurricanes and tornadoes).

6.E.2B.3 Develop and use models to represent how solar energy and convection impact Earth's weather patterns and climate conditions (including global winds, the jet stream, and ocean currents).

6.E.2B.4 Construct explanations for how climate is determined in an area (including latitude, elevation, shape of the land, distance from water, global winds, and ocean currents).

GRADE SIX
PHYSICAL SCIENCE: ENERGY TRANSFER AND CONSERVATION

Standard 6.P.3: The student will demonstrate an understanding of the properties of energy, the transfer and conservation of energy, and the relationship between energy and forces.

6.P.3A. Conceptual Understanding: Energy manifests itself in multiple forms, such as mechanical (kinetic energy and potential energy), electrical, chemical, radiant (solar), and thermal energy. According to the principle of conservation of energy, energy cannot be created nor destroyed, but it can be transferred from one place to another and transformed between systems.

Performance Indicators: Students who demonstrate this understanding can:

6.P.3A.1 Analyze and interpret data to describe the properties and compare sources of different forms of energy (including mechanical, electrical, chemical, radiant, and thermal).

6.P.3A.2 Develop and use models to exemplify the conservation of energy as it is transformed from kinetic to potential (gravitational and elastic) and vice versa.

6.P.3A.3 Construct explanations for how energy is conserved as it is transferred and transformed in electrical circuits.

6.P.3A.4 Develop and use models to exemplify how magnetic fields produced by electrical energy flow in a circuit is interrelated in electromagnets, generators, and simple electrical motors.

6.P.3A.5 Develop and use models to describe and compare the directional transfer of heat through convection, radiation, and conduction.

6.P.3A.6 Design and test devices that minimize or maximize heat transfer by conduction, convection, or radiation.

6.P.3B. Conceptual Understanding: Energy transfer occurs when two objects interact thereby exerting force on each other. It is the property of an object or a system that enables it to do work (force moving an object over a distance). Machines are governed by this application of energy, work, and conservation of energy.

Performance Indicators: Students who demonstrate this understanding can:

6.P.3B.1 Plan and conduct controlled scientific investigations to provide evidence for how the design of simple machines (including levers, pulleys, inclined planes) helps transfer mechanical energy by reducing the amount of force required to do work.

6.P.3B.2 Design and test solutions that improve the efficiency of a machine by reducing the input energy (effort) or the amount of energy transferred to the surrounding environment as it moves an object.

GRADE SIX
LIFE SCIENCE: DIVERSITY OF LIFE – CLASSIFICATION AND ANIMALS

Standard 6.L.4: The student will demonstrate an understanding of how scientists classify organisms and how the structures, processes, behaviors, and adaptations of animals allow them to survive.

6.L.4A. Conceptual Understanding: Life is the quality that differentiates living things (organisms) from nonliving objects or those that were once living. All organisms are made up of cells, need food and water, a way to dispose of waste, and an environment in which they can live. Because of the diversity of life on Earth, scientists have developed a way to organize groups of organisms according to their characteristic traits, making it easier to identify and study them.

Performance Indicators: Students who demonstrate this understanding can:

6.L.4A.1 Obtain and communicate information to support claims that living organisms (1) obtain and use resources for energy, (2) respond to stimuli, (3) reproduce, and (4) grow and develop.

6.L.4A.2 Develop and use models to classify organisms based on the current hierarchical taxonomic structure (including the kingdoms of protists, plants, fungi, and animals).

6.L.4B. Conceptual Understanding: The Animal Kingdom includes a diversity of organisms that have many characteristics in common. Classification of animals is based on structures that function in growth, reproduction, and survival. Animals have both structural and behavioral adaptations that increase the chances of reproduction and survival in changing environments.

Performance Indicators: Students who demonstrate this understanding can:

6.L.4B.1 Analyze and interpret data related to the diversity of animals to support claims that all animals (vertebrates and invertebrates) share common characteristics.

6.L.4B.2 Obtain and communicate information to explain how the structural adaptations and processes of animals allow for defense, movement, or resource obtainment.

6.L.4B.3 Construct explanations of how animal responses (including hibernation, migration, grouping, and courtship) to environmental stimuli allow them to survive and reproduce.

6.L.4B.4 Obtain and communicate information to compare and classify innate and learned behaviors in animals.

6.L.4B.5 Analyze and interpret data to compare how endothermic and ectothermic animals respond to changes in environmental temperature.

GRADE SIX
LIFE SCIENCE: DIVERSITY OF LIFE – PROTISTS, FUNGI AND PLANTS

Standard 6.L.5: The student will demonstrate an understanding of the structures, processes, and responses that allow protists, fungi, and plants to survive and reproduce.

6.L.5A. Conceptual Understanding: The Protist Kingdom is one of the most diverse groups and includes organisms that have characteristics similar to but are not classified as plants, animals, or fungi. These microorganisms live in moist environments and vary in how they obtain energy and move. The Fungi Kingdom consists of organisms that do not make their own food (heterotrophs) but obtain their nutrition through external absorption. Fungi can be grouped by their growth habit or fruiting structure and respond to changes in the environmental stimuli similar to plants.

Performance Indicators: Students who demonstrate this understanding can:

6.L.5A.1 Analyze and interpret data from observations to compare how the structures of protists (including euglena, paramecium, and amoeba) and fungi allow them to obtain energy and explore their environment.

6.L.5A.2 Analyze and interpret data to describe how fungi respond to external stimuli (including temperature, light, touch, water, and gravity).

6.L.5B. Conceptual Understanding: The Plant Kingdom consists of organisms that primarily make their own food (autotrophs) and are commonly classified based on internal structures that function in the transport of food and water. Plants have structural and behavioral adaptations that increase the chances of reproduction and survival in changing environments.

Performance Indicators: Students who demonstrate this understanding can:

6.L.5B.1 Construct explanations of how the internal structures of vascular and nonvascular plants transport food and water.

6.L.5B.2 Analyze and interpret data to explain how the processes of photosynthesis, respiration, and transpiration work together to meet the needs of plants.

6.L.5B.3 Develop and use models to compare structural adaptations and processes that flowering plants use for defense, survival and reproduction.

6.L.5B.4 Plan and conduct controlled scientific investigations to determine how changes in environmental factors (such as air, water, light, minerals, or space) affect the growth and development of a flowering plant.

6.L.5B.5 Analyze and interpret data to describe how plants respond to external stimuli (including temperature, light, touch, water, and gravity).

GRADE 7 OVERVIEW

In grades six through eight, the standards and performance indicators for the science and engineering practices and core science content, transition students to developing and planning controlled investigations to create more explicit and detailed models and explanations. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom. Science in the middle school provides students with the foundation to be successful in high school science courses, by providing a range of content in the life, earth, and physical sciences.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade seven.

The four core areas of the grade seven standards include:

- Classification and Conservation of Matter
- Organization in Living Systems
- Heredity – Inheritance and Variation of Traits
- Interactions of Living Systems and the Environment

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations

The academic standards and performance indicators for grade seven should be the basis for the development of classroom and grade-level assessments. In addition, these standards and performance indicators will be the basis for the development of items on the state-required South Carolina Palmetto Assessment of State Standards (SC-PASS). Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science courses.

GRADE SEVEN
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 7.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

7.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

7.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

7.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

7.S.1A.3 Plan and conduct controlled scientific investigation to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

7.S.1A.4. Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

7.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

7.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

7.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

7.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

7.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

7.S.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

GRADE SEVEN
PHYSICAL SCIENCE: CLASSIFICATION AND CONSERVATION OF MATTER

Standard 7.P.2: The student will demonstrate an understanding of the structure and properties of matter and that matter is conserved as it undergoes changes.

7.P.2A. Conceptual Understanding: All substances are composed of one or more elements. Elements are pure substances which contain only one kind of atom. The periodic table organizes these elements based on similar properties. Compounds are substances composed of two or more elements. Chemical formulas can be used to describe compounds.

Performance Indicators: Students who demonstrate this understanding can:

7.P.2A.1 Develop and use simple atomic models to illustrate the components of elements (including the relative position and charge of protons, neutrons, and electrons).

7.P.2A.2 Obtain and use information about elements (including chemical symbol, atomic number, atomic mass, and group or family) to describe the organization of the periodic table.

7.P.2A.3 Analyze and interpret data to describe and classify matter as pure substances (elements or compounds) or mixtures (heterogeneous or homogeneous) based on composition.

7.P.2A.4 Construct explanations for how compounds are classified as ionic (metal bonded to nonmetal) or covalent (nonmetals bonded together) using chemical formulas.

7.P.2B. Conceptual Understanding: Substances (such as metals or acids) are identified according to their physical or chemical properties. Changes to substances can either be physical or chemical. Many substances react chemically with other substances to form new substances with different properties. According to the law of conservation of matter, total mass does not change in a chemical reaction.

7.P.2B.1 Analyze and interpret data to describe substances using physical properties (including state, boiling/melting point, density, conductivity, color, hardness, and magnetic properties) and chemical properties (the ability to burn or rust).

7.P.2B.2 Use mathematical and computational thinking to describe the relationship between the mass, volume, and density of a given substance.

7.P.2B.3 Analyze and interpret data to compare the physical properties, chemical properties (neutralization to form a salt, reaction with metals), and pH of various solutions and classify solutions as acids or bases.

7.P.2B.4 Plan and conduct controlled scientific investigations to answer questions about how physical and chemical changes affect the properties of different substances.

7.P.2B.5 Develop and use models to explain how chemical reactions are supported by the law of conservation of matter.

GRADE SEVEN
LIFE SCIENCE: ORGANIZATION IN LIVING SYSTEMS

Standard 7.L.3: The student will demonstrate an understanding of how the levels of organization within organisms support the essential functions of life.

7.L.3A. Conceptual Understanding: Cells are the most basic unit of any living organism. All organisms are composed of one (unicellular) or many cells (multicellular) and require food and water, a way to dispose of waste, and an environment in which they can live in order to survive. Through the use of technology, scientists have discovered special structures within individual cells that have specific functions that allow the cell to grow, survive, and reproduce. Bacteria are one-celled organisms found almost everywhere and can be both helpful and harmful. They can be simply classified by their size, shape and whether or not they can move.

Performance Indicators: Students who demonstrate this understanding can:

7.L.3A.1 Obtain and communicate information to support claims that (1) organisms are made of one or more cells, (2) cells are the basic unit of structure and function of organisms, and (3) cells come only from existing cells.

7.L.3A.2 Analyze and interpret data from observations to describe different types of cells and classify cells as plant, animal, protist, or bacteria.

7.L.3A.3 Develop and use models to explain how the relevant structures within cells (including cytoplasm, cell membrane, cell wall, nucleus, mitochondria, chloroplasts, lysosomes, and vacuoles) function to support the life of plant, animal, and bacterial cells.

7.L.3A.4 Construct scientific arguments to support claims that bacteria are both helpful and harmful to other organisms and the environment.

7.L.3B. Conceptual Understanding: Multicellular organisms (including humans) are complex systems with specialized cells that perform specific functions. Organs and organ systems are composed of cells that function to serve the needs of cells which in turn serve the needs of the organism.

Performance Indicators: Students who demonstrate this understanding can:

7.L.3B.1 Develop and use models to explain how the structural organizations within multicellular organisms function to serve the needs of the organism.

7.L.3B.2 Construct explanations for how systems in the human body (including circulatory, respiratory, digestive, excretory, nervous, and musculoskeletal systems) work together to support the essential life functions of the body.

GRADE SEVEN
LIFE SCIENCE: HEREDITY – INHERITANCE AND VARIATION OF TRAITS

Standard 7.L.4: The student will demonstrate an understanding of how genetic information is transferred from parent to offspring and how environmental factors and the use of technologies influence the transfer of genetic information.

7.L.4A. Conceptual Understanding: Inheritance is the key process causing similarities between parental organisms and their offspring. Organisms that reproduce sexually transfer genetic information (DNA) to their offspring. This transfer of genetic information through inheritance leads to greater similarity among individuals within a population than between populations. Technology allows humans to influence the transfer of genetic information.

Performance Indicators: Students who demonstrate this understanding can:

7.L.4A.1 Obtain and communicate information about the relationship between genes and chromosomes to construct explanations of their relationship to inherited characteristics.

7.L.4A.2 Construct explanations for how genetic information is transferred from parent to offspring in organisms that reproduce sexually.

7.L.4A.3 Develop and use models (Punnett squares) to describe and predict patterns of the inheritance of single genetic traits from parent to offspring (including dominant and recessive traits, incomplete dominance, and codominance).

7.L.4A.4 Use mathematical and computational thinking to predict the probability of phenotypes and genotypes based on patterns of inheritance.

7.L.4A.5 Construct scientific arguments using evidence to support claims for how changes in genes (mutations) may have beneficial, harmful, or neutral effects on organisms.

7.L.4A.6 Construct scientific arguments using evidence to support claims concerning the advantages and disadvantages of the use of technology (such as selective breeding, genetic engineering, or biomedical research) in influencing the transfer of genetic information.

GRADE SEVEN
ECOLOGY: INTERACTIONS OF LIVING SYSTEMS AND THE ENVIRONMENT

Standard 7.EC.5: The student will demonstrate an understanding of how organisms interact with and respond to the biotic and abiotic components of their environments.

7.EC.5A. Conceptual Understanding: In all ecosystems, organisms and populations of organisms depend on their environmental interactions with other living things (biotic factors) and with physical (abiotic) factors (such as light, temperature, water, or soil quality). Disruptions to any component of an ecosystem can lead to shifts in its diversity and abundance of populations.

Performance Indicators: Students who demonstrate this understanding can:

7.EC.5A.1 Develop and use models to describe the characteristics of the levels of organization within ecosystems (including species, populations, communities, ecosystems, and biomes).

7.EC.5A.2 Construct explanations of how soil quality (including composition, texture, particle size, permeability, and pH) affects the characteristics of an ecosystem using evidence from soil profiles.

7.EC.5A.3 Analyze and interpret data to predict changes in the number of organisms within a population when certain changes occur to the physical environment (such as changes due to natural hazards or limiting factors).

7.EC.5B. Conceptual Understanding: Organisms in all ecosystems interact with and depend upon each other. Organisms with similar needs compete for limited resources. Food webs and energy pyramids are models that demonstrate how energy is transferred within an ecosystem.

Performance Indicators: Students who demonstrate this understanding can:

7.EC.5B.1 Develop and use models to explain how organisms interact in a competitive or mutually beneficial relationship for food, shelter, or space (including competition, mutualism, commensalism, parasitism, and predator-prey relationships).

7.EC.5B.2 Develop and use models (food webs and energy pyramids) to exemplify how the transfer of energy in an ecosystem supports the concept that energy is conserved.

7.EC.5B.3 Analyze and interpret data to predict how changes in the number of organisms of one species affects the balance of an ecosystem.

7.EC.5B.4 Define problems caused by the introduction of a new species in an environment and design devices or solutions to minimize the impact(s) to the balance of an ecosystem.

GRADE 8 OVERVIEW

In grades six through eight, the standards and performance indicators for the science and engineering practices and core science content, transition students to developing and planning controlled investigations to create more explicit and detailed models and explanations. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom. Science in the middle school provides students with the foundation to be successful in high school science courses, by providing a range of content in the life, earth, and physical sciences.

These academic standards and performance indicators establish the practices and core content that South Carolina's students should know and be able to do by the end of grade eight.

The five core areas of the grade eight standards include:

- Forces and Motion
- Waves
- Earth's Place in the Universe
- Earth Systems and Resources
- Earth's History and Diversity of Life

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for their grade level. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to provide a wide variety of experiences, materials, and instructional strategies that accommodate a broad range of individual differences. These standards support active engagement in learning. Classrooms will need to be supplied with the materials and equipment necessary to complete scientific investigations

The academic standards and performance indicators for grade eight should be the basis for the development of classroom and grade-level assessments. In addition, these standards and performance indicators will be the basis for the development of items on the state-required South Carolina Palmetto Assessment of State Standards (SC-PASS). Students must demonstrate knowledge of the science and engineering practices and core content ideas in preparation for future science courses.

GRADE EIGHT
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected at this grade level. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard 8.S.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

8.S.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

8.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

8.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

8.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

8.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

8.S.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) collect and analyze data, (3) express relationships between variables for models and investigations, or (4) use grade-level appropriate statistics to analyze data.

8.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

8.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.

8.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

8.S.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

8.S.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

GRADE EIGHT
PHYSICAL SCIENCE: FORCES AND MOTION

Standard 8.P.2: The student will demonstrate an understanding of the effects of forces on the motion and stability of an object.

8.P.2A. Conceptual Understanding: Motion occurs when there is a change in position of an object with respect to a reference point. The final position of an object is determined by measuring the change in position and direction of the segments along a trip. While the speed of the object may vary during the total time it is moving, the average speed is the result of the total distance divided by the total time taken. Forces acting on an object can be balanced or unbalanced. Varying the amount of force or mass will affect the motion of an object. Inertia is the tendency of objects to resist any change in motion.

Performance Indicators: Students who demonstrate this understanding can:

8.P.2A.1 Plan and conduct controlled scientific investigations to test how varying the amount of force or mass of an object affects the motion (speed and direction), shape, or orientation of an object.

8.P.2A.2 Develop and use models to compare and predict the resulting effect of balanced and unbalanced forces on an object's motion in terms of magnitude and direction.

8.P.2A.3 Construct explanations for the relationship between the mass of an object and the concept of inertia (Newton's First Law of Motion).

8.P.2A.4 Analyze and interpret data to support claims that for every force exerted on an object there is an equal force exerted in the opposite direction (Newton's Third Law of Motion).

8.P.2A.5 Analyze and interpret data to describe and predict the effects of forces (including gravitational and friction) on the speed and direction of an object.

8.P.2A.6 Use mathematical and computational thinking to generate graphs that represent the motion of an object's position and speed as a function of time.

8.P.2A.7 Use mathematical and computational thinking to describe the relationship between the speed and velocity (including positive and negative expression of direction) of an object in determining average speed (v=d/t).

GRADE EIGHT
PHYSICAL SCIENCE: WAVES

Standard 8.P.3: The student will demonstrate an understanding of the properties and behaviors of waves.

8.P.3A. Conceptual Understanding: Waves (including sound and seismic waves, waves on water, and light waves) have energy and transfer energy when they interact with matter. Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter. All types of waves have some features in common. When waves interact, they superimpose upon or interfere with each other resulting in changes to the amplitude. Major modern technologies are based on waves and their interactions with matter.

Performance Indicators: Students who demonstrate this understanding can:

8.P.3A.1 Construct explanations of the relationship between matter and energy based on the characteristics of mechanical and light waves.

8.P.3A.2 Develop and use models to exemplify the basic properties of waves (including frequency, amplitude, wavelength, and speed).

8.P.3A.3 Analyze and interpret data to describe the behavior of waves (including refraction, reflection, transmission, and absorption) as they interact with various materials.

8.P.3A.4 Analyze and interpret data to describe the behavior of mechanical waves as they intersect.

8.P.3A.5 Construct explanations for how humans see color as a result of the transmission, absorption, and reflection of light waves by various materials.

8.P.3A.6 Obtain and communicate information about how various instruments are used to extend human senses by transmitting and detecting waves (such as radio, television, cell phones, and wireless computer networks) to exemplify how technological advancements and designs meet human needs.

GRADE EIGHT
EARTH SCIENCE: EARTH'S PLACE IN THE UNIVERSE

Standard 8.E.4: The student will demonstrate an understanding of the universe and the predictable patterns caused by Earth's movement in the solar system.

8.E.4A. Conceptual Understanding: Earth's solar system is part of the Milky Way Galaxy, which is one of many galaxies in the universe. The planet Earth is a tiny part of a vast universe that has developed over a span of time beginning with a period of extreme and rapid expansion.

Performance Indicators: Students who demonstrate this understanding can:

8.E.4A.1 Obtain and communicate information to model the position of the Sun in the universe, the shapes and composition of galaxies, and the measurement unit needed to identify star and galaxy locations.

8.E.4A.2 Construct and analyze scientific arguments to support claims that the universe began with a period of extreme and rapid expansion using evidence from the composition of stars and gases and the motion of galaxies in the universe.

8.E.4B. Conceptual Understanding: Earth's solar system consists of the Sun and other objects that are held in orbit around the Sun by its gravitational pull on them. Motions within the Earth-Moon-Sun system have effects that can be observed on Earth.

Performance Indicators: Students who demonstrate this understanding can:

8.E.4B.1 Obtain and communicate information to model and compare the characteristics and movements of objects in the solar system (including planets, moons, asteroids, comets, and meteors).

8.E.4B.2 Construct explanations for how gravity affects the motion of objects in the solar system and tides on Earth.

8.E.4B.3 Develop and use models to explain how seasons, caused by the tilt of Earth's axis as it orbits the Sun, affects the length of the day and the amount of heating on Earth's surface.

8.E.4B.4 Develop and use models to explain how motions within the Sun-Earth-Moon system cause Earth phenomena (including day and year, moon phases, solar and lunar eclipses, and tides).

8.E.4B.5 Obtain and communicate information to describe how data from technologies (including telescopes, spectroscopes, satellites, space probes) provide information about objects in the solar system and the universe.

8.E.4B.6 Analyze and interpret data from the surface features of the Sun (including photosphere, corona, sunspots, prominences, and solar flares) to predict how these features may affect Earth.

GRADE EIGHT
EARTH SCIENCE: EARTH SYSTEMS AND RESOURCES

Standard 8.E.5: The student will demonstrate an understanding of the processes that alter the structure of Earth and provide resources for life on the planet.

8.E.5A. Conceptual Understanding: All Earth processes are the result of energy flowing and matter cycling within and among Earth's systems. Because Earth's processes are dynamic and interactive in nature, the surface of Earth is constantly changing. Earth's hot interior is a main source of energy that drives the cycling and moving of materials. Plate tectonics is the unifying theory that explains the past and current crustal movements at the Earth's surface. This theory provides a framework for understanding geological history.

Performance Indicators: Students who demonstrate this understanding can:

8.E.5A.1 Develop and use models to explain how the processes of weathering, erosion, and deposition change surface features in the environment.

8.E.5A.2 Use the rock cycle model to describe the relationship between the processes and forces that create igneous, sedimentary, and metamorphic rocks.

8.E.5A.3 Obtain and communicate information about the relative position, density, and composition of Earth's layers to describe the crust, mantle, and core.

8.E.5A.4 Construct explanations for how the theory of plate tectonics accounts for (1) the motion of lithospheric plates, (2) the geologic activities at plate boundaries, and (3) the changes in landform areas over geologic time.

8.E.5A.5 Construct and analyze scientific arguments to support claims that plate tectonics accounts for (1) the distribution of fossils on different continents, (2) the occurrence of earthquakes, and (3) continental and ocean floor features (including mountains, volcanoes, faults and trenches).

8.E.5B. Conceptual Understanding: Natural processes can cause sudden or gradual changes to Earth's systems. Some may adversely affect humans such as volcanic eruptions or earthquakes. Mapping the history of natural hazards in a region, combined with an understanding of related geological forces can help forecast the locations and likelihoods of future events.

Performance Indicators: Students who demonstrate this understanding can:

8.E.5B.1 Analyze and interpret data to describe patterns in the location of volcanoes and earthquakes related to tectonic plate boundaries, interactions, and hot spots.

8.E.5B.2 Construct explanations of how forces inside Earth result in earthquakes and volcanoes.

8.E.5B.3 Define problems that may be caused by a catastrophic event resulting from plate movements and design possible devices or solutions to minimize the effects of that event on Earth's surface and/or human structures.

8.E.5C. Conceptual Understanding: Humans depend upon many Earth resources – some renewable over human lifetimes and some nonrenewable or irreplaceable. Resources are distributed unevenly around the planet as a result of past geological processes.

Performance Indicators: Students who demonstrate this understanding can:

8.E.5C.1 Obtain and communicate information regarding the physical and chemical properties of minerals, ores, and fossil fuels to describe their importance as Earth resources.

GRADE EIGHT
EARTH SCIENCE: EARTH'S HISTORY AND DIVERSITY OF LIFE

Standard 8.E.6: The student will demonstrate an understanding of Earth's geologic history and its diversity of life over time.

8.E.6A. Conceptual Understanding: The geologic time scale interpreted from rock strata provides a way to organize major historical events in Earth's history. Analysis of rock strata and the fossil record, which documents the existence, diversity, extinction, and change of many life forms throughout history, provide only relative dates, not an absolute scale. Changes in life forms are shaped by Earth's varying geological conditions.

Performance Indicators: Students who demonstrate this understanding can:

8.E.6A.1 Develop and use models to organize Earth's history (including era, period, and epoch) according to the geologic time scale using evidence from rock layers.

8.E.6A.2 Analyze and interpret data from index fossil records and the ordering of rock layers to infer the relative age of rocks and fossils.

8.E.6A.3 Construct explanations from evidence for how catastrophic events (including volcanic activities, earthquakes, climatic changes, and the impact of an asteroid/comet) may have affected the conditions on Earth and the diversity of its life forms.

8.E.6A.4 Construct and analyze scientific arguments to support claims that different types of fossils provide evidence of (1) the diversity of life that has been present on Earth, (2) relationships between past and existing life forms, and (3) environmental changes that have occurred during Earth's history.

8.E.6A.5 Construct explanations for why most individual organisms, as well as some entire taxonomic groups of organisms, that lived in the past were never fossilized.

8.E.6B. Conceptual Understanding: Adaptation by natural selection acting over generations is one important process by which species change in response to changes in environmental conditions. The resources of biological communities can be used within sustainable limits, but if the ecosystem becomes unbalanced in ways that prevent the sustainable use of resources, then ecosystem degradation and species extinction can occur.

Performance Indicators: Students who demonstrate this understanding can:

8.E.6B.1 Construct explanations for how biological adaptations and genetic variations of traits in a population enhance the probability of survival in a particular environment.

8.E.6B.2 Obtain and communicate information to support claims that natural and human-made factors can contribute to the extinction of species.

Academic Standards and Performance Indicators for Science

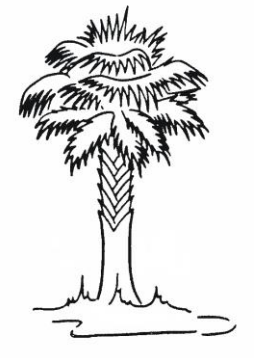
High School Course Standards

In grades nine through twelve, the standards and performance indicators for the science and engineering practices and core science content for the high school courses transition students to developing more abstract models and explanations to understand concepts in greater detail and sophistication as they build from experiences in kindergarten through grade eight. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

These courses should not only serve as the foundation for advanced studies at the secondary level and in institutions of higher education but should also provide students with the science skills that are necessary for informed decision making regarding scientific societal questions and to lay the foundation for skills necessary for science related technical careers.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for the course. It is critical that educators understand the Science and Engineering Practices are *not* to be taught in isolation. There should *not* be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed *within the content* for each grade level.

In South Carolina, students are required to have a minimum of three (3) science units for high school graduation. Students must also pass a high school course in science in which an end-of-course examination is administered. At the time this document was written, the required course was Biology.



BIOLOGY 1 OVERVIEW

The academic standards and performance indicators establish the practices and core content for all Biology courses in South Carolina high schools. The core ideas within the standards are not meant to represent an equal division of material and concepts. Therefore, the number of indicators per core idea should not be expected to be equal, nor should equal numbers of performance indicators within each standard be expected.

The five core areas of the Biology 1 course standards include:

- Cells as a System
- Energy Transfer
- Heredity – Inheritance and Variation of Traits
- Biological Evolution – Unity and Diversity
- Ecosystem Dynamics

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for the course. It is critical that educators understand the Science and Engineering Practices are *not* to be taught in isolation. There should *not* be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed *within the content* for each grade level.

Teachers, schools, and districts should use these standards and indicators to make decisions concerning the structure and content of Biology 1 courses. All biology courses must include instruction in the practices of science and engineering, allowing students to engage in problem solving, decision making, critical thinking, and applied learning. All biology courses are laboratory courses requiring a minimum of 30% hands-on investigation. Biology laboratories will need to be stocked with the materials and equipment necessary to complete investigations.

The academic standards and performance indicators for Biology 1 should be the basis for the development of classroom and course-level assessments. In addition, the academic standards and performance indicators for Biology 1 will be the basis for the development of the items on the state-required End-of-Course Examination Program (EOCEP) for Biology 1.

BIOLOGY 1
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected in this course. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard H.B.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

H.B.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

H.B.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.

H.B.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.B.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

H.B.1A.4 Analyze and interpret data from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

H.B.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, and (3) use grade-level appropriate statistics to analyze data.

H.B.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

H.B.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.

H.B.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

H.B.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

H.B.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

BIOLOGY 1
CELLS AS A SYSTEM

Standard H.B.2: The student will demonstrate the understanding that the essential functions of life take place within cells or systems of cells.

H.B.2A. Conceptual Understanding: The essential functions of a cell involve chemical reactions that take place between many different types of molecules (including carbohydrates, lipids, proteins and nucleic acids) and are catalyzed by enzymes.

Performance Indicators: Students who demonstrate this understanding can:

H.B.2A.1 Construct explanations of how the structures of carbohydrates, lipids, proteins, and nucleic acids (including DNA and RNA) are related to their functions in organisms.

H.B.2A.2 Plan and conduct investigations to determine how various environmental factors (including temperature and pH) affect enzyme activity and the rate of biochemical reactions.

H.B.2B. Conceptual Understanding: Organisms and their parts are made of cells. Cells are the structural units of life and have specialized substructures that carry out the essential functions of life. Viruses lack cellular organization and therefore cannot independently carry out all of the essential functions of life.

Performance Indicators: Students who demonstrate this understanding can:

H.B.2B.1 Develop and use models to explain how specialized structures within cells (including the nucleus, chromosomes, cytoskeleton, endoplasmic reticulum, ribosomes and Golgi complex) interact to produce, modify, and transport proteins. Models should compare and contrast how prokaryotic cells meet the same life needs as eukaryotic cells without similar structures.

H.B.2B.2 Collect and interpret descriptive data on cell structure to compare and contrast different types of cells (including prokaryotic versus eukaryotic, and animal versus plant versus fungal).

H.B.2B.3 Obtain information to contrast the structure of viruses with that of cells and to explain, in general, why viruses must use living cells to reproduce.

H.B.2C. Conceptual Understanding: Transport processes which move materials into and out of the cell serve to maintain the homeostasis of the cell.

Performance Indicators: Students who demonstrate this understanding can:

H.B.2C.1 Develop and use models to exemplify how the cell membrane serves to maintain homeostasis of the cell through both active and passive transport processes.

H.B.2C.2 Ask scientific questions to define the problems that organisms face in maintaining homeostasis within different environments (including water of varying solute concentrations).

H.B.2C.3 Analyze and interpret data to explain the movement of molecules (including water) across a membrane.

H.B.2D. Conceptual Understanding: The cells of multicellular organisms repeatedly divide to make more cells for growth and repair. During embryonic development, a single cell gives rise to a complex, multicellular organism through the processes of both cell division and differentiation.

Performance Indicators: Students who demonstrate this understanding can:

H.B.2D.1 Construct models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms.

H.B.2D.2 Develop and use models to exemplify the changes that occur in a cell during the cell cycle (including changes in cell size, chromosomes, cell membrane/cell wall, and the number of cells produced) and predict, based on the models, what might happen to a cell that does not progress through the cycle correctly.

H.B.2D.3 Construct explanations for how the cell cycle is monitored by check point systems and communicate possible consequences of the continued cycling of abnormal cells.

H.B.2D.4 Construct scientific arguments to support the pros and cons of biotechnological applications of stem cells using examples from both plants and animals.

BIOLOGY 1
ENERGY TRANSFER

Standard H.B.3: The student will demonstrate the understanding that all essential processes within organisms require energy which in most ecosystems is ultimately derived from the Sun and transferred into chemical energy by the photosynthetic organisms of that ecosystem.

H.B.3A. Conceptual Understanding: Cells transform energy that organisms need to perform essential life functions through a complex sequence of reactions in which chemical energy is transferred from one system of interacting molecules to another.

Performance Indicators: Students who demonstrate this understanding can:

H.B.3A.1 Develop and use models to explain how chemical reactions among ATP, ADP, and inorganic phosphate act to transfer chemical energy within cells.

H.B.3A.2 Develop and revise models to describe how photosynthesis transforms light energy into stored chemical energy.

H.B.3A.3 Construct scientific arguments to support claims that chemical elements in the sugar molecules produced by photosynthesis may interact with other elements to form amino acids, lipids, nucleic acids or other large organic molecules.

H.B.3A.4 Develop models of the major inputs and outputs of cellular respiration (aerobic and anaerobic) to exemplify the chemical process in which the bonds of molecules are broken, the bonds of new compounds are formed and a net transfer of energy results.

H.B.3A.5 Plan and conduct scientific investigations or computer simulations to determine the relationship between variables that affect the processes of fermentation and/or cellular respiration in living organisms and interpret the data in terms of real-world phenomena.

BIOLOGY 1
HEREDITY – INHERITANCE AND VARIATION OF TRAITS

Standard H.B.4: The student will demonstrate an understanding of the specific mechanisms by which characteristics or traits are transferred from one generation to the next via genes.

H.B.4A. Conceptual Understanding: Each chromosome consists of a single DNA molecule. Each gene on the chromosome is a particular segment of DNA. The chemical structure of DNA provides a mechanism that ensures that information is preserved and transferred to subsequent generations.

Performance Indicators: Students who demonstrate this understanding can:

H.B.4A.1 Develop and use models at different scales to explain the relationship between DNA, genes, and chromosomes in coding the instructions for characteristic traits transferred from parent to offspring.

H.B.4A.2 Develop and use models to explain how genetic information (DNA) is copied for transmission to subsequent generations of cells (mitosis).

H.B.4B. Conceptual Understanding: In order for information stored in DNA to direct cellular processes, a gene needs to be transcribed from DNA to RNA and then must be translated by the cellular machinery into a protein or an RNA molecule. The protein and RNA products from these processes determine cellular activities and the unique characteristics of an individual. Modern techniques in biotechnology can manipulate DNA to solve human problems.

Performance Indicators: Students who demonstrate this understanding can:

H.B.4B.1 Develop and use models to describe how the structure of DNA determines the structure of resulting proteins or RNA molecules that carry out the essential functions of life.

H.B.4B.2 Obtain, evaluate and communicate information on how biotechnology (including gel electrophoresis, plasmid-based transformation and DNA fingerprinting) may be used in the fields of medicine, agriculture, and forensic science.

H.B.4C. Conceptual Understanding: Sex cells are formed by a process of cell division in which the number of chromosomes per cell is halved after replication. With the exception of sex chromosomes, for each chromosome in the body cells of a multicellular organism, there is a second similar, but not identical, chromosome. Although these pairs of similar chromosomes can carry the same genes, they may have slightly different alleles. During meiosis the pairs of similar chromosomes may cross and trade pieces. One chromosome from each pair is randomly passed on to form sex cells resulting in a multitude of possible genetic combinations. The cell produced during fertilization has one set of chromosomes from each parent.

Performance Indicators: Students who demonstrate this understanding can:

H.B.4C.1 Develop and use models of sex cell formation (meiosis) to explain why the DNA of the daughter cells is different from the DNA of the parent cell.

H.B.4C.2 Analyze data on the variation of traits among individual organisms within a population to explain patterns in the data in the context of transmission of genetic information.

H.B.4C.3 Construct explanations for how meiosis followed by fertilization ensures genetic variation among offspring within the same family and genetic diversity within populations of sexually reproducing organisms.

H.B.4D. Conceptual Understanding: Imperfect transmission of genetic information may have positive, negative, or no consequences to the organism. DNA replication is tightly regulated and remarkably accurate, but errors do occur and result in mutations which (rarely) are a source of genetic variation.

Performance Indicators: Students who demonstrate this understanding can:

H.B.4D.1 Develop and use models to explain how mutations in DNA that occur during replication (1) can affect the proteins that are produced or the traits that result and (2) may or may not be inherited.

BIOLOGY 1
ECOSYSTEM DYNAMICS

Standard H.B.6: The student will demonstrate an understanding that ecosystems are complex, interactive systems that include both biological communities and physical components of the environment.

H.B.6A. Conceptual Understanding: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. Limiting factors include the availability of biotic and abiotic resources and challenges such as predation, competition, and disease.

Performance Indicators: Students who demonstrate this understanding can:

H.B.6A.1 Analyze and interpret data that depict changes in the abiotic and biotic components of an ecosystem over time or space (such as percent change, average change, correlation and proportionality) and propose hypotheses about possible relationships between the changes in the abiotic components and the biotic components of the environment.

H.B.6A.2 Use mathematical and computational thinking to support claims that limiting factors affect the number of individuals that an ecosystem can support.

H.B.6B. Conceptual Understanding: Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.

Performance Indicators: Students who demonstrate this understanding can:

H.B.6B.1 Develop and use models of the carbon cycle, which include the interactions between photosynthesis, cellular respiration and other processes that release carbon dioxide, to evaluate the effects of increasing atmospheric carbon dioxide on natural and agricultural ecosystems.

H.B.6B.2 Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases (such as carbon dioxide and methane) on the carbon cycle and global climate.

H.B.6C. Conceptual Understanding: A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively stable over long periods of time. Fluctuations in conditions can challenge the functioning of ecosystems in terms of resource and habitat availability.

Performance Indicators: Students who demonstrate this understanding can:

H.B.6C.1 Construct scientific arguments to support claims that the changes in the biotic and abiotic components of various ecosystems over time affect the ability of an ecosystem to maintain homeostasis.

BIOLOGY 1
ECOSYSTEM DYNAMICS *(CONTINUED)*

H.B.6D. Conceptual Understanding: Sustaining biodiversity maintains ecosystem functioning and productivity which are essential to supporting and enhancing life on Earth. Humans depend on the living world for the resources and other benefits provided by biodiversity. Human activity can impact biodiversity.

Performance Indicators: Students who demonstrate this understanding can:

H.B.6D.1 Design solutions to reduce the impact of human activity on the biodiversity of an ecosystem.

CHEMISTRY 1 OVERVIEW

The academic standards and performance indicators establish the practices and core content for all Chemistry 1 courses in South Carolina high schools. The core ideas within the standards are not meant to represent an equal division of material and concepts. Therefore the number of indicators per core idea should not be expected to be equal, nor should equal numbers of performance indicators within each standard be expected.

The six core areas of the Chemistry 1 standards include:

- Atomic Structure and Nuclear Processes
- Bonding and Chemical Formulas
- States of Matter
- Solutions, Acids, and Bases
- Chemical Reactions
- Thermochemistry and Chemical Kinetics

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for the course. It is critical that educators understand the Science and Engineering Practices are *not* to be taught in isolation. There should *not* be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed *within the content* for each grade level.

Teachers, schools, and districts should use these standards and indicators to make decisions concerning the structure and content of Chemistry 1. All chemistry courses must include instruction in the practices of science and engineering, allowing students to engage in problem solving, decision making, critical thinking, and applied learning. All chemistry courses are laboratory courses requiring a minimum of 30 % hands-on investigation. Chemistry laboratories will need to be stocked with the materials and equipment necessary to complete scientific investigations.

The academic standards and performance indicators for Chemistry 1 should be the basis for the development of classroom and course-level assessments.

CHEMISTRY 1
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected in this course. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard H.C.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

H.C.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

H.C.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.

H.C.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.C.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

H.C.1A.4 Analyze and interpret data from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

H.C.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, and (3) use grade-level appropriate statistics to analyze data.

H.C.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

H.C.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.

H.C.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

H.C.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

H.C.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

CHEMISTRY 1
ATOMIC STRUCTURE AND NUCLEAR PROCESSES

Standard H.C.2: The student will demonstrate an understanding of atomic structure and nuclear processes.

H.C.2A. Conceptual Understanding: The existence of atoms can be used to explain the structure and behavior of matter. Each atom consists of a charged nucleus, consisting of protons and neutrons, surrounded by electrons. The interactions of these electrons between and within atoms are the primary factors that determine the chemical properties of matter. In a neutral atom the number of protons is the same as the number of electrons.

Performance Indicators: Students who demonstrate this understanding can:

H.C.2A.1 Obtain and communicate information to describe and compare subatomic particles with regard to mass, location, charge, electrical attractions and repulsions, and impact on the properties of an atom.

H.C.2A.2 Use the Bohr and quantum mechanical models of atomic structure to exemplify how electrons are distributed in atoms.

H.C.2A.3 Analyze and interpret absorption and emission spectra to support explanations that electrons have discrete energy levels.

H.C.2B. Conceptual Understanding: In nuclear fusion, lighter nuclei combine to form more stable heavier nuclei and in nuclear fission heavier nuclei are split to form lighter nuclei. The energies in fission and fusion reactions exceed the energies in usual chemical reactions.

Performance Indicators: Students who demonstrate this understanding can:

H.C.2B.1 Obtain and communicate information to compare alpha, beta, and gamma radiation in terms of mass, charge, penetrating power, and their practical applications (including medical benefits and associated risks).

H.C.2B.2 Develop models to exemplify radioactive decay and use the models to explain the concept of half-life and its use in determining the age of materials (such as radiocarbon dating or the use of radioisotopes to date rocks).

H.C.2B.3 Obtain and communicate information to compare and contrast nuclear fission and nuclear fusion and to explain why the ability to produce low energy nuclear reactions would be a scientific breakthrough.

H.C.2B.4 Use mathematical and computational thinking to explain the relationship between mass and energy in nuclear reactions ($E=mc^2$).

CHEMISTRY 1
BONDING AND CHEMICAL FORMULAS

Standard H.C.3: The student will demonstrate an understanding of the structures and classification of chemical compounds.

H.C.3A. Conceptual Understanding: Elements are made up of only one kind of atom. With increasing atomic number, a predictable pattern for the addition of electrons exists. This pattern is the basis for the arrangement of elements in the periodic table. The chemical properties of an element are determined by an element's electron configuration. Elements can react to form chemical compounds/molecules that have unique properties determined by the kinds of atoms combined to make up the compound/molecule. Essentially, the ways in which electrons are involved in bonds determines whether ionic or covalent bonds are formed. Compounds have characteristic shapes that are determined by the type and number of bonds formed.

Performance Indicators: Students who demonstrate this understanding can:

H.C.3A.1 Construct explanations for the formation of molecular compounds via sharing of electrons and for the formation of ionic compounds via transfer of electrons.

H.C.3A.2 Use the periodic table to write and interpret the formulas and names of chemical compounds (including binary ionic compounds, binary covalent compounds, and straight-chain alkanes up to six carbons).

H.C.3A.3 Analyze and interpret data to predict the type of bonding (ionic or covalent) and the shape of simple compounds by using the Lewis dot structures and oxidation numbers.

H.C.3A.4 Plan and conduct controlled scientific investigations to generate data on the properties of substances and analyze the data to infer the types of bonds (including ionic, polar covalent, and nonpolar covalent) in simple compounds.

H.C.3A.5 Develop and use models (such as Lewis dot structures, structural formulas, or ball-and-stick models) of simple hydrocarbons to exemplify structural isomerism.

H.C.3A.6 Construct explanations of how the basic structure of common natural and synthetic polymers is related to their bulk properties.

H.C.3A.7 Analyze and interpret data to determine the empirical formula of a compound and the percent composition of a compound.

CHEMISTRY 1
STATES OF MATTER

Standard H.C.4: The student will demonstrate an understanding of the structure and behavior of the different states of matter.

H.C.4A. Conceptual Understanding: Matter can exist as a solid, liquid, or gas, and in very high-energy states, as plasma. In general terms, for a given chemical, the particles making up the solid are at a lower energy state than the liquid phase, which is at a lower energy state than the gaseous phase. The changes from one state of matter into another are energy dependent. The behaviors of gases are dependent on the factors of pressure, volume, and temperature.

Performance Indicators: Students who demonstrate this understanding can:

H.C.4A.1 Develop and use models to explain the arrangement and movement of the particles in solids, liquids, gases**,** and plasma as well as the relative strengths of their intermolecular forces.

H.C.4A.2 Analyze and interpret heating curve graphs to explain that changes from one state of matter to another are energy dependent.

H.C.4A.3 Conduct controlled scientific investigations and use models to explain the behaviors of gases (including the proportional relationships among pressure, volume, and temperature).

CHEMISTRY 1
SOLUTIONS, ACIDS, AND BASES

Standard H.C.5: The student will demonstrate an understanding of the nature and properties of various types of chemical solutions.

H.C.5A. Conceptual Understanding: Solutions can exist in any of three physical states: gas, liquid, or solid. Solution concentrations can be expressed by specifying the relative amounts of solute and solvent. The nature of the solute, the solvent, the temperature, and the pressure can affect solubility. Solutes can affect such solvent properties as freezing point, boiling point, and vapor pressure. Acids, bases, and salts have characteristic properties. Several definitions of acids and bases are used in chemistry.

Performance Indicators: Students who demonstrate this understanding can:

H.C.5A.1 Obtain and communicate information to describe how a substance can dissolve in water by dissociation, dispersion, or ionization and how intermolecular forces affect solvation.

H.C.5A.2 Analyze and interpret data to explain the effects of temperature and pressure on the solubility of solutes in a given amount of solvent.

H.C.5A.3 Use mathematical representations to analyze the concentrations of unknown solutions in terms of molarity and percent by mass.

H.C.5A.4 Analyze and interpret data to describe the properties of acids, bases, and salts.

CHEMISTRY 1
CHEMICAL REACTIONS

Standard H.C.6: The student will demonstrate an understanding of the types, the causes, and the effects of chemical reactions.

H.C.6A. Conceptual Understanding: A chemical reaction occurs when elements and/or compounds interact, resulting in a rearrangement of the atoms of these elements and/or compounds to produce substances with unique properties. Mass is conserved in chemical reactions. Reactions tend to proceed in a direction that favors lower energies. Chemical reactions can be categorized using knowledge about the reactants to predict products. Chemical reactions are quantifiable. When stress is applied to a chemical system that is in equilibrium, the system will shift in a direction that reduces that stress.

Performance Indicators: Students who demonstrate this understanding can:

H.C.6A.1 Develop and use models to predict the products of chemical reactions (1) based upon movements of ions; (2) based upon movements of protons; and (3) based upon movements of electrons.

H.C.6A.2 Use Le Châtelier's principle to predict shifts in chemical equilibria resulting from changes in concentration, pressure, and temperature.

H.C.6A.3 Plan and conduct controlled scientific investigations to produce mathematical evidence that mass is conserved in chemical reactions.

H.C.6A.4 Use mathematical and computational thinking to predict the amounts of reactants required and products produced in specific chemical reactions.

CHEMISTRY 1
THERMOCHEMISTRY AND CHEMICAL KINETICS

Standard H.C.7: The student will demonstrate an understanding of the conservation of energy and energy transfer.

H.C.7A. Conceptual Understanding: The first law of thermodynamics states that the amount of energy in the universe is constant. An energy diagram is used to represent changes in the energy of the reactants and products in a chemical reaction. Enthalpy refers to the heat content that is present in an atom, ion, or compound. While some chemical reactions occur spontaneously, other reactions may require that activation energy be lowered in order for the reaction to occur.

Performance Indicators: Students who demonstrate this understanding can:

H.C.7A.1 Analyze and interpret data from energy diagrams and investigations to support claims that the amount of energy released or absorbed during a chemical reaction depends on changes in total bond energy.

H.C.7A.2 Use mathematical and computational thinking to write thermochemical equations and draw energy diagrams for the combustion of common hydrocarbon fuels and carbohydrates, given molar enthalpies of combustion.

H.C.7A.3 Plan and conduct controlled scientific investigations to determine the effects of temperature, surface area, stirring, concentration of reactants, and the presence of various catalysts on the rate of chemical reactions.

H.C.7A.4 Develop and use models to explain the relationships between collision frequency, the energy of collisions, the orientation of molecules, activation energy, and the rates of chemical reactions.

PHYSICS 1 OVERVIEW

The academic standards and performance indicators establish the practices and core content for all Physics 1 courses in South Carolina schools. The two core ideas are subdivided and are not meant to represent an equal division of material and concepts. Therefore the number of indicators per core idea should not be expected to be equal, nor should equal numbers of performance indicators within each standard be expected.

The two core areas of the Physics 1 standards include:

- Interactions and Forces: Patterns of Linear Motion; Forces and Changes in Motion; Interactions and Contact Forces; Interactions and Noncontact Forces and Fields
- Interactions and Energy: Conservation and Energy Transfer and Work; Mechanical Energy; Thermal Energy; Sound, Electricity and Magnetism; Radiation; Nuclear Energy

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for the course. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to make decisions concerning the structure and content of Physics 1. All Physics courses must include instruction in the practices of science and engineering, allowing students to engage in problem solving, decision making, critical thinking, and applied learning. All Physics courses are laboratory courses requiring a minimum of 30 % hands-on investigation. Physics laboratories will need to be stocked with the materials and equipment necessary to complete investigations.

The academic standards and performance indicators for Physics 1 should be the basis for the development of classroom and course-level assessments.

PHYSICS 1
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected in this course. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard H.P.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

H.P.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

H.P.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.

H.P.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.P.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

H.P.1A.4 Analyze and interpret data from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

H.P.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate English and metric units, (2) express relationships between variables for models and investigations, or (3) use grade-level appropriate statistics to analyze data.

H.P.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

H.P.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.

H.P.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

H.P.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

H.P.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

PHYSICS 1
INTERACTIONS AND FORCES

Standard H.P.2: The student will demonstrate an understanding of how the interactions among objects and their subsequent motion can be explained and predicted using the concept of forces.

H.P.2A. Conceptual Understanding: The linear motion of an object can be described by its displacement, velocity, and acceleration.

Performance Indicators: Students who demonstrate this understanding can:

H.P.2A.1 Plan and conduct controlled scientific investigations on the straight-line motion of an object to include an interpretation of the object's displacement, time of motion, constant velocity, average velocity, and constant acceleration.

H.P.2A.2 Construct explanations for an object's change in motion using one-dimensional vector addition.

H.P.2A.3 Use mathematical and computational thinking to apply formulas related to an object's displacement, constant velocity, average velocity and constant acceleration. Interpret the meaning of the sign of displacement, velocity, and acceleration.

H.P.2A.4 Develop and use models to represent an object's displacement, velocity, and acceleration (including vector diagrams, data tables, motion graphs, dot motion diagrams, and mathematical formulas).

H.P.2A.5 Construct explanations for what is meant by "constant" velocity and "constant" acceleration (including writing descriptions of the object's motion and calculating the sign and magnitude of the slope of the line on a position-time and velocity-time graph).

H.P.2A.6 Obtain information to communicate the similarities and differences between distance and displacement; speed and velocity; constant velocity and instantaneous velocity; constant velocity and average velocity; and velocity and acceleration.

PHYSICS 1
INTERACTIONS AND FORCES *(CONTINUED)*

H.P.2B. Conceptual Understanding: The interactions among objects and their subsequent motion can be explained and predicted by analyzing the forces acting on the objects and applying Newton's laws of motion.

Performance Indicators: Students who demonstrate this understanding can:

H.P.2B.1 Plan and conduct controlled scientific investigations involving the motion of an object to determine the relationships among the net force on the object, its mass, and its acceleration (Newton's second law of motion, $F_{net} = ma$) and analyze collected data to construct an explanation of the object's motion using Newton's second law of motion.

H.P.2B.2 Use a free-body diagram to represent the forces on an object.

H.P.2B.3 Use Newton's Third Law of Motion to construct explanations of everyday phenomena (such as a hammer hitting a nail, the thrust of a rocket engine, the lift of an airplane wing, or a book at rest on a table) and identify the force pairs in each given situation involving two objects and compare the size and direction of each force.

H.P.2B.4 Use mathematical and computational thinking to derive the relationship between impulse and Newton's Second Law of Motion.

H.P.2B.5 Plan and conduct controlled scientific investigations to support the Law of Conservation of Momentum in the context of two objects moving linearly (p=mv).

H.P.2B.6 Construct scientific arguments to defend the use of the conservation of linear momentum in the investigation of traffic accidents in which the initial motions of the objects are used to determine the final motions of the objects.

H.P.2B.7 Apply physics principles to design a device that minimizes the force on an object during a collision and construct an explanation for the design.

H.P.2B.8 Develop and use models (such as a computer simulation, drawing, or demonstration) and Newton's Second Law of Motion to construct explanations for why an object moving at a constant speed in a circle is accelerating.

H.P.2B.9 Construct explanations for the practical applications of torque (such as a see-saw, bolt, wrench, and hinged door).

H.P.2B.10 Obtain information to communicate physical situations in which Newton's Second Law of Motion does not apply.

PHYSICS 1
INTERACTIONS AND FORCES *(CONTINUED)*

H.P.2C. Conceptual Understanding: The contact interactions among objects and their subsequent motion can be explained and predicted by analyzing the normal, tension, applied, and frictional forces acting on the objects and by applying Newton's Laws of Motion.

Performance Indicators: Students who demonstrate this understanding can:

H.P.2C.1 Use a free-body diagram to represent the normal, tension (or elastic), applied, and frictional forces on an object.

H.P.2C.2 Plan and conduct controlled scientific investigations to determine the variables that could affect the kinetic frictional force on an object.

H.P.2C.3 Obtain and evaluate information to compare kinetic and static friction.

H.P.2C.4 Analyze and interpret data on force and displacement to determine the spring (or elastic) constant of an elastic material (Hooke's Law, F=-kx), including constructing an appropriate graph in order to draw a line-of-best-fit whose calculated slope will yield the spring constant, *k*.

H.P.2C.5 Use mathematical and computational thinking to apply F_{net} = ma to analyze problems involving contact interactions and gravity.

PHYSICS 1
INTERACTIONS AND FORCES *(CONTINUED)*

H.P.2D. Conceptual Understanding: The non-contact (at a distance) interactions among objects and their subsequent motion can be explained and predicted by analyzing the gravitational, electric, and magnetic forces acting on the objects and applying Newton's laws of motion. These non-contact forces can be represented as fields.

Performance Indicators: Students who demonstrate this understanding can:

H.P.2D.1 Develop and use models (such as computer simulations, demonstrations, diagrams, and drawings) to explain how neutral objects can become charged and how objects mutually repel or attract each other and include the concept of conservation of charge in the explanation.

H.P.2D.2 Use mathematical and computational thinking to predict the relationships among the masses of two objects, the attractive gravitational force between them, and the distance between them (Newton's Law of Universal Gravitation, $F=Gm_1m_2/r^2$).

H.P.2D.3 Obtain information to communicate how long-term gravitational interactions govern the evolution and maintenance of large-scale structures in the universe (such as the solar system and galaxies) and the patterns of motion within them.

H.P.2D.4 Use mathematical and computational thinking to predict the relationships among the charges of two particles, the attractive or repulsive electrical force between them, and the distance between them (Coulomb's Law. $F=kq_1q_2/r^2$).

H.P.2D.5 Construct explanations for how the non-contact forces of gravity, electricity, and magnetism can be modeled as fields by sketching field diagrams for two given charges, two massive objects, or a bar magnet and use these diagrams to qualitatively interpret the direction and magnitude of the force at a particular location in the field.

H.P.2D.6 Use a free-body diagram to represent the gravitational force on an object.

H.P.2D.7 Use a free-body diagram to represent the electrical force on a charge.

H.P.2D.8 Develop and use models (such as computer simulations, drawings, or demonstrations) to explain the relationship between moving charged particles (current) and magnetic forces and fields.

H.P.2D.9 Use Newton's Law of Universal Gravitation and Newton's second law of motion to explain why all objects near Earth's surface have the same acceleration.

H.P.2D.10 Use mathematical and computational thinking to apply $F_{net} = ma$ to analyze problems involving non-contact interactions, including objects in free fall.

PHYSICS 1
INTERACTIONS AND ENERGY

Standard H.P.3: The student will demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of the conservation of energy.

H.P.3A. Conceptual Understanding: Work and energy are equivalent to each other. Work is defined as the product of displacement and the force causing that displacement; this results in the transfer of mechanical energy. Therefore, in the case of mechanical energy, energy is seen as the ability to do work. This is called the work-energy principle. The rate at which work is done (or energy is transformed) is called power. For machines that do useful work for humans, the ratio of useful power output is the efficiency of the machine. For all energies and in all instances, energy in a closed system remains constant.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3A.1 Use mathematical and computational thinking to determine the work done by a constant force (W=Fd).

H.P.3A.2 Use mathematical and computational thinking to analyze problems dealing with the work done on or by an object and its change in energy.

H.P.3A.3 Obtain information to communicate how energy is conserved in elastic and inelastic collisions.

H.P.3A.4 Plan and conduct controlled scientific investigations to determine the power output of the human body.

H.P.3A.5 Obtain and communicate information to describe the efficiency of everyday machines (such as automobiles, hair dryers, refrigerators, and washing machines).

H.P.3B. Conceptual Understanding: Mechanical energy refers to a combination of motion (kinetic energy) and stored energy (potential energy). When only conservative forces act on an object and when no mass is converted to energy, mechanical energy is conserved. Gravitational and electrical potential energy can be modeled as energy stored in the fields created by massive objects or charged particles.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3B.1 Develop and use models (such as computer simulations, drawings, bar graphs, and diagrams) to exemplify the transformation of mechanical energy in simple systems and those with periodic motion and on which only conservative forces act.

H.P.3B.2 Use mathematical and computational thinking to argue the validity of the conservation of mechanical energy in simple systems and those with periodic motion and on which only conservative forces act ($KE = \frac{1}{2} mv^2$, $PE_g = mgh$, $PE_e = \frac{1}{2} kx^2$).

H.P.3B.3 Use drawings or diagrams to identify positions of relative high and low potential energy in a gravitational and electrical field (with the source of the field being positive as well as negative and the charge experiencing the field being positive as well as negative).

H.P.3C. Conceptual Understanding: When there is a temperature difference between two objects, an interaction occurs in the form of a transfer of thermal energy (heat) from the hotter object to the cooler object. Thermal energy is the total internal kinetic energy of the molecules and/or atoms of a system and is related to temperature, which is the average kinetic energy of the particles of a system. Energy always flows from hot to cold through the processes of conduction, convection, or radiation.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3C.1 Plan and conduct controlled scientific investigations to determine the variables that affect the rate of heat transfer between two objects.

H.P.3C.2 Analyze and interpret data to describe the thermal conductivity of different materials.

H.P.3C.3 Develop and use models (such as a drawing or a small-scale greenhouse) to exemplify the energy balance of the Earth (including conduction, convection, and radiation).

H.P.3D. Conceptual Understanding: Sound is a mechanical, longitudinal wave that is the result of vibrations (kinetic energy) that transfer energy through a medium.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3D.1 Develop and use models (such as drawings) to exemplify the interaction of mechanical waves with different boundaries (sound wave interference) including the formation of standing waves and two-source interference patterns.

H.P.3D.2 Use the principle of superposition to explain everyday examples of resonance (including musical instruments and the human voice).

H.P.3D.3 Develop and use models to explain what happens to the observed frequency of a sound wave when the relative positions of an observer and wave source changes (Doppler effect).

H.P.3D.4 Use mathematical and computational thinking to analyze problems that relate the frequency, period, amplitude, wavelength, velocity, and energy of sound waves.

PHYSICS 1
INTERACTIONS AND ENERGY *(CONTINUED)*

H.P.3E. Conceptual Understanding: During electric circuit interactions, electrical energy (energy stored in a battery or energy transmitted by a current) is transformed into other forms of energy and transferred to circuit devices and the surroundings. Charged particles and magnets create fields that store energy. Magnetic fields exert forces on moving charged particles. Changing magnetic fields cause electrons in wires to move, creating current.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3E.1 Plan and conduct controlled scientific investigations to determine the relationship between the current and potential drop (voltage) across an Ohmic resistor. Analyze and interpret data to verify Ohm's law, including constructing an appropriate graph in order to draw a line-of-best-fit whose calculated slope will yield *R*, the resistance of the resistor.

H.P.3E.2 Develop and use models (such as circuit drawings and mathematical representations) to explain how an electric circuit works by tracing the path of the electrons and including concepts of energy transformation, transfer, and the conservation of energy and electric charge.

H.P.3E.3 Use mathematical and computational thinking to analyze problems dealing with current, electric potential, resistance, and electric charge.

H.P.3E.4 Use mathematical and computational thinking to analyze problems dealing with the power output of electric devices.

H.P.3E.5 Plan and conduct controlled scientific investigations to determine how connecting resistors in series and in parallel affects the power (brightness) of light bulbs.

H.P.3E.6 Obtain and communicate information about the relationship between magnetism and electric currents to explain the role of magnets and coils of wire in microphones, speakers, generators, and motors.

H.P.3E.7 Design a simple motor and construct an explanation of how this motor transforms electrical energy into mechanical energy and work.

PHYSICS 1
INTERACTIONS AND ENERGY *(CONTINUED)*

H.P.3F. Conceptual Understanding: During radiant energy interactions, energy can be transferred over long distances without a medium. Radiation can be modeled as an electromagnetic wave or as a stream of discrete packets of energy (photons); all radiation travels at the same speed in a vacuum (speed of light). This electromagnetic radiation is a major source of energy for life on Earth.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3F.1 Construct scientific arguments that support the wave model of light and the particle model of light.

H.P.3F.2 Plan and conduct controlled scientific investigations to determine the interaction between the visible light portion of the electromagnetic spectrum and various objects (including mirrors, lenses, barriers with two slits, and diffraction gratings) and to construct explanations of the behavior of light (reflection, refraction, transmission, interference) in these instances using models (including ray diagrams).

H.P.3F.3 Use drawings to exemplify the behavior of light passing from one transparent medium to another and construct explanations for this behavior.

H.P.3F.4 Use mathematical and computational thinking to analyze problems that relate the frequency, period, amplitude, wavelength, velocity, and energy of light.

H.P.3F.5 Obtain information to communicate the similarities and differences among the different bands of the electromagnetic spectrum (including radio waves, microwaves, infrared, visible light, ultraviolet, and gamma rays) and give examples of devices or phenomena from each band.

H.P.3F.6 Obtain information to construct explanations on how waves are used to produce, transmit, and capture signals and store and interpret information (including ultrasound imaging, telescopes, cell phones, and bar code scanners).

PHYSICS 1
INTERACTIONS AND ENERGY *(CONTINUED)*

H.P.3G. Conceptual Understanding: Nuclear energy is energy stored in an atom's nucleus; this energy holds the atom together and is called binding energy. Binding energy is a reflection of the equivalence of mass and energy; the mass of any nucleus is always less than the sum of the masses of the individual constituent nucleons that comprise it. Binding energy is also a measure of the strong nuclear force that exists in the nucleus and is responsible for overcoming the repulsive forces among protons. The strong and weak nuclear forces, gravity, and the electromagnetic force are the fundamental forces in nature. Strong and weak nuclear forces determine nuclear sizes, stability, and rates of radioactive decay. At the subatomic scale, the conservation of energy becomes the conservation of mass-energy.

Performance Indicators: Students who demonstrate this understanding can:

H.P.3G.1 Develop and use models to represent the basic structure of an atom (including protons, neutrons, electrons, and the nucleus).

H.P.3G.2 Develop and use models (such as drawings, diagrams, computer simulations, and demonstrations) to communicate the similarities and differences between fusion and fission. Give examples of fusion and fission reactions and include the concept of conservation of mass-energy.

H.P.3G.3 Construct scientific arguments to support claims for or against the viability of fusion and fission as sources of usable energy.

H.P.3G.4 Use mathematical and computational thinking to predict the products of radioactive decay (including alpha, beta, and gamma decay).

H.P.3G.5 Obtain information to communicate how radioactive decay processes have practical applications (such as food preservation, cancer treatments, fossil and rock dating, and as radioisotopic medical tracers).

EARTH SCIENCE OVERVIEW

The academic standards and performance indicators establish the practices and core content for all Earth Science courses in South Carolina schools. The core ideas within the standards are not meant to represent an equal division of material and concepts. Therefore the number of indicators per core idea should not be expected to be equal, nor should equal numbers of performance indicators within each standard be expected.

The five core areas of the Earth Science standards include:

- Astronomy
- Earth's Geosphere
- Earth's Paleobiosphere
- Earth's Atmosphere – Weather and Climate
- Earth's Hydrosphere

The eight science and engineering practices describe how students should learn and demonstrate knowledge of the content outlined in the content standards. Engaging in these practices will help students become scientifically literate and astute consumers of scientific information. The seven core concepts (patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change) are reinforced in the appropriate context of the core science content through hands-on instruction in the classroom.

Students should engage in scientific and engineering practices as a means to learn about the specific topics identified for the course. It is critical that educators understand the Science and Engineering Practices are ***not*** to be taught in isolation. There should ***not*** be a distinct "Inquiry" unit at the beginning of each school year. Rather, the practices need to be employed ***within the content*** for each grade level.

Teachers, schools, and districts should use these standards and indicators to make decisions concerning the structure and content of an Earth Science course. All Earth Science courses must include instruction in the practices of science and engineering, allowing students to engage in problem solving, decision making, critical thinking, and applied learning. All Earth Science courses are laboratory courses requiring a minimum of 30% hands-on investigation. Earth Science laboratories will need to be stocked with the materials and equipment necessary to complete investigations.

The academic standards and performance indicators for Earth Science should be the basis for the development of classroom and course-level assessments.

EARTH SCIENCE
SCIENCE AND ENGINEERING PRACTICES

NOTE: Scientific investigations should always be done in the context of content knowledge expected in this course. The standard describes how students should learn and demonstrate knowledge of the content outlined in the other standards.

Standard H.E.1: The student will use the science and engineering practices, including the processes and skills of scientific inquiry, to develop understandings of science content.

H.E.1A. Conceptual Understanding: The practices of science and engineering support the development of science concepts, develop the habits of mind that are necessary for scientific thinking, and allow students to engage in science in ways that are similar to those used by scientists and engineers.

Performance Indicators: Students who demonstrate this understanding can:

H.E.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge scientific arguments or claims.

H.E.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

H.E.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses based on credible scientific information, (2) identify materials, procedures, and variables, (3) use appropriate laboratory equipment, technology, and techniques to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

H.E.1A.4 Analyze and interpret data from informational texts and data collected from investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning, (2) support or refute hypotheses, explanations, claims, or designs, or (3) evaluate the strength of conclusions.

H.E.1A.5 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for models and investigations, or (3) use grade-level appropriate statistics to analyze data.

H.E.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

H.E.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence and valid reasoning from observations, data, or informational texts.

H.E.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

H.E.1B. Conceptual Understanding: Technology is any modification to the natural world created to fulfill the wants and needs of humans. The engineering design process involves a series of iterative steps used to solve a problem and often leads to the development of a new or improved technology.

Performance Indicators: Students who demonstrate this understanding can:

H.E.1B.1 Construct devices or design solutions using scientific knowledge to solve specific problems or needs: (1) ask questions to identify problems or needs, (2) ask questions about the criteria and constraints of the device or solutions, (3) generate and communicate ideas for possible devices or solutions, (4) build and test devices or solutions, (5) determine if the devices or solutions solved the problem and refine the design if needed, and (6) communicate the results.

EARTH SCIENCE
ASTRONOMY

Standard H.E.2: The student will demonstrate an understanding of the structure, properties, and history of the observable universe.

H.E.2A. Conceptual Understanding: Earth is a tiny part of a vast universe that has developed over a huge expanse of time. At the center of Earth's solar system is one local star, the Sun. It is just one of a vast number of stars in the Milky Way Galaxy, which is just one of a vast number of galaxies in the observable universe. The study of the light spectra and brightness of stars is used to identify compositional elements of stars, their movements, and their distances from Earth. Nearly all observable matter in the universe formed and continues to form within the cores of stars. The universe began with a period of extreme and rapid expansion and has been expanding ever since.

Performance Indicators: Students who demonstrate this understanding can:

H.E.2A.1 Construct explanations for how gravity and motion affect the formation and shapes of galaxies (including the Milky Way Galaxy).

H.E.2A.2 Use the Hertzsprung-Russell diagram to classify stars and explain the life cycles of stars (including the Sun).

H.E.2A.3 Construct explanations for how elements are formed using evidence from nuclear fusion occurring within stars and/or supernova explosions.

H.E.2A.4 Construct and analyze scientific arguments to support claims about the origin of the universe (including the red shift of light from distant galaxies, the measured composition of stars and nonstellar gases, and the cosmic background radiation).

H.E.2A.5 Obtain and evaluate information to describe how the use of x-ray, gamma-ray, radio, and visual (reflecting, refracting, and catadioptric) telescopes and computer modeling have increased the understanding of the universe.

H.E.2B. Conceptual Understanding: The solar system consists of the Sun and a collection of objects of varying sizes and conditions – including planets and their moons – that have predictable patterns of movement. These patterns can be explained by gravitational forces and conservation laws, and in turn explains many large-scale phenomena observed on Earth. Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the Sun. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

Performance Indicators: Students who demonstrate this understanding can:

H.E.2B.1 Analyze and interpret data to compare the properties of Earth and other planets (including composition, density, surface expression of tectonics, climate, and conditions necessary for life).

H.E.2B.2 Obtain, evaluate, and communicate information about the properties and features of the moon to support claims that it is unique among other moons in the solar system in its effects on the planet it orbits.

H.E.2B.3 Use mathematical and computational thinking to explain the motion of an orbiting object in the solar system.

H.E.2B.4 Construct explanations for how the solar system was formed.

EARTH SCIENCE
EARTH'S GEOSPHERE

Standard H.E.3: The student will demonstrate an understanding of the internal and external dynamics of Earth's geosphere.

H.E.3A. Conceptual Understanding: Evidence indicates Earth's interior is divided into a solid inner core, a liquid outer core, a solid (but flowing) mantle and solid crust. Although the crust is solid, it is in constant motion and is recycled through time. Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a coherent account of its geological history. Weathering (physical and chemical) and soil formation are a result of the interactions of Earth's geosphere, hydrosphere, and atmosphere. All forms of resource extraction and land use have associated economic, social, environmental, and geopolitical costs, risks, and benefits. Natural hazards and other geological events have shaped the course of human history.

Performance Indicators: Students who demonstrate this understanding can:

H.E.3A.1 Analyze and interpret data to explain the differentiation of Earth's internal structure using (1) the production of internal heat from the radioactive decay of unstable isotopes, (2) gravitational energy, (3) data from seismic waves, and (4) Earth's magnetic field.

H.E.3A.2 Analyze and interpret data from ocean topography, correlation of rock assemblages, the fossil record, the role of convection current, and the action at plate boundaries to explain the theory of plate tectonics.

H.E.3A.3 Construct explanations of how forces cause crustal changes as evidenced in sea floor spreading, earthquake activity, volcanic eruptions, and mountain building using evidence of tectonic environments (such as mid-ocean ridges and subduction zones).

H.E.3A.4 Use mathematical and computational thinking to analyze seismic graphs to (1) triangulate the location of an earthquake's epicenter and magnitude, and (2) describe the correlation between frequency and magnitude of an earthquake.

H.E.3A.5 Analyze and interpret data to describe the physical and chemical properties of minerals and rocks and classify each based on the properties and environment in which they were formed.

H.E.3A.6 Develop and use models to explain how various rock formations on the surface of Earth result from geologic processes (including weathering, erosion, deposition, and glaciation).

H.E.3A.7 Plan and conduct controlled scientific investigations to determine the factors that affect the rate of weathering.

H.E.3A.8 Analyze and interpret data of soil from different locations to compare the major physical components of soil (such as the amounts of sand, silt, clay, and humus) as evidence of Earth processes in that region producing each type of soil.

H.E.3B. Conceptual Understanding: The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. Human transformation of the natural environment can contribute to the frequency and intensity of some natural hazards.

Performance Indicators: Students who demonstrate this understanding can:

H.E.3B.1 Obtain and communicate information to explain how the formation, availability, and use of ores and fossil fuels impact the environment.

H.E.3B.2 Construct scientific arguments to support claims that responsible management of natural resources is necessary for the sustainability of human societies and the biodiversity that supports them.

H.E.3B.3 Analyze and interpret data to explain how natural hazards and other geologic events have shaped the course of human history.

H.E.3B.4 Obtain and evaluate available data on a current controversy regarding human activities which may affect the frequency, intensity, or consequences of natural hazards.

H.E.3B.5 Define problems caused by the impacts of locally significant natural hazards and design possible devices or solutions to reduce the impacts of such natural hazards on human activities.

EARTH SCIENCE
EARTH'S PALEOBIOSPHERE

Standard H.E.4: The student will demonstrate an understanding of the dynamic relationship between Earth's conditions over geologic time and the diversity of organisms.

H.E.4A. Conceptual Understanding: Living things have changed the makeup of Earth's geosphere, hydrosphere, and atmosphere over geological time. Organisms ranging from bacteria to human beings may contribute to the global carbon cycle. They may influence the global climate by modifying the chemical makeup of the atmosphere. As Earth changes, life on Earth adapts and evolves to those changes. Just as life influences components of the Earth System, changes in the Earth System influences life.

Performance Indicators: Students who demonstrate this understanding can:

H.E.4A.1 Construct scientific arguments to support claims that the physical conditions of Earth enable the planet to support carbon-based life.

H.E.4A.2 Construct explanations for how various life forms have altered the geosphere, hydrosphere and atmosphere over geological time.

H.E.4A.3 Construct explanations of how changes to Earth's surface are related to changes in the complexity and diversity of life using evidence from the geologic time scale.

H.E.4A.4 Obtain and evaluate evidence from rock and fossil records and ice core samples to support claims that Earth's environmental conditions have changed over time.

H.E.4A.5 Develop and use models of various dating methods (including index fossils, ordering of rock layers, and radiometric dating) to estimate geologic time.

H.E.4A.6 Use mathematical and computational thinking to calculate the age of Earth materials using isotope ratios (actual or simulated).

H.E.4A.7 Develop and use models to predict the effects of an environmental change (such as the changing life forms, tectonic change, or human activity) on global carbon cycling.

EARTH SCIENCE
EARTH'S ATMOSPHERE – WEATHER AND CLIMATE

Standard H.E.5: The student will demonstrate an understanding of the dynamics of Earth's atmosphere.

H.E.5A. Conceptual Understanding: Weather is the condition of the atmosphere at a particular location at a particular time. Weather is primarily determined by the angle and amount (time) of sunlight. Climate is the general weather conditions over a long period of time and is influenced by many factors.

Performance Indicators: Students who demonstrate this understanding can:

H.E.5A.1 Develop and use models to describe the thermal structures (including the changes in air temperature due to changing altitude in the lower troposphere), the gaseous composition, and the location of the layers of Earth's atmosphere.

H.E.5A.2 Develop and use models to predict and explain how the angle of solar incidence and Earth's axial tilt impact (1) the length of daylight, (2) the atmospheric filtration, (3) the distribution of sunlight in any location, and (4) seasonal changes.

H.E.5A.3 Analyze and interpret data to predict local and national weather conditions on the basis of the relationship among the movement of air masses, pressure systems, and frontal boundaries.

H.E.5A.4 Analyze and interpret data of pressure differences, the direction of winds, and areas of uneven heating to explain how convection determines local wind patterns (including land/sea breezes, mountain/valley breezes, Chinook winds, and monsoons).

H.E.5A.5 Construct explanations for the formation of severe weather conditions (including tornadoes, hurricanes, thunderstorms, and blizzards) using evidence from temperature, pressure and moisture conditions.

H.E.5A.6 Develop and use models to exemplify how climate is driven by global circulation patterns.

H.E.5A.7 Construct scientific arguments to support claims of past changes in climate caused by various factors (such as changes in the atmosphere, variations in solar output, Earth's orbit, changes in the orientation of Earth's axis of rotation, or changes in the biosphere).

H.E.5A.8 Analyze scientific arguments regarding the nature of the relationship between human activities and climate change.

EARTH SCIENCE
EARTH'S HYDROSPHERE

Standard H.E.6: The student will demonstrate an understanding of Earth's freshwater and ocean systems.

H.E.6A. Conceptual Understanding: Water is an essential resource on Earth. Organisms (including humans) on Earth depend on water for life. Its unique physical and chemical properties are important to the dynamics of Earth systems. Multiple factors affect the quality, availability, and distribution of Earth's water.

Performance Indicators: Students who demonstrate this understanding can:

H.E.6A.1 Analyze and interpret data to describe and compare the physical and chemical properties of saltwater and freshwater.

H.E.6A.2 Obtain and communicate information to explain how location, movement, and energy transfers are involved in making water available for use on Earth's surface (including lakes, surface-water drainage basins, freshwater wetlands, and groundwater zones).

H.E.6A.3 Plan and conduct controlled scientific investigations to determine how a change in stream flow might affect areas of erosion and deposition of a meandering alluvial stream.

H.E.6A.4 Analyze and interpret data of a local drainage basin to predict how changes caused by human activity and other factors influence the hydrology of the basin and amount of water available for use in the ecosystem.

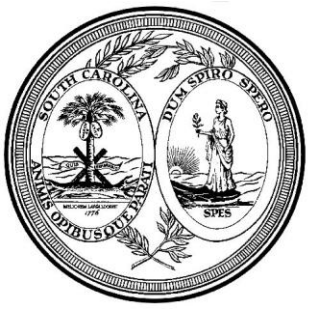
H.E.6A.5 Analyze and interpret data to describe how the quality of the water in drainage basins is influenced by natural and human factors (such as land use, domestic and industrial waste, weather/climate conditions, topography of the river channel, pollution, or flooding).

H.E.6A.6 Develop and use models to explain how groundwater processes affect limestone formations leading to the formation of caves and karst topography.

H.E.6A.7 Obtain and communicate information to explain how the convection of ocean water due to temperature and density influence the circulation of oceans.

H.E.6A.8 Develop and use models to describe how waves and currents interact with the ocean shore.

H.E.6A.9 Ask questions about the designs of devices used to control and prevent coastal erosion and flooding and evaluate the designs in terms of the advantages and disadvantages required for solving the problems.



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