New Jersey Core Curriculum Content Standards
for
Science

INTRODUCTION

Science Education in the 21st Century

"*Today more than ever before, science holds the key to our survival as a planet and our security and prosperity as a nation*" (Obama, 2008).

Scientific literacy assumes an increasingly important role in the context of globalization. The rapid pace of technological advances, access to an unprecedented wealth of information, and the pervasive impact of science and technology on day-to day-living require a depth of understanding that can be enhanced through quality science education. In the 21st century, science education focuses on the practices of science that lead to a greater understanding of the growing body of scientific knowledge that is required of citizens in an ever-changing world.

Mission: *Scientifically literate students possess the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.*

Vision: A quality science education fosters a population that:

- Experiences the richness and excitement of knowing about the natural world and understanding how it functions.
- Uses appropriate scientific processes and principles in making personal decisions.
- Engages intelligently in public discourse and debate about matters of scientific and technological concern.
- Applies scientific knowledge and skills to increase economic productivity.

Intent and Spirit of the Science Standards

"Scientific proficiency encompasses understanding key concepts and their connections to other fundamental concepts and principles of science; familiarity with the natural and designed world for both its diversity and unity; and use of scientific knowledge and scientific ways of thinking for individual and social purposes" (American Association for the Advancement of Science, 1990).

All students engage in science experiences that promote the ability to ask, find, or determine answers to questions derived from natural curiosity about everyday things and occurrences. The underpinning of the revised standards lies in the premise that science is experienced as an *active* process in which inquiry is central to learning and in which students engage in observation, inference, and experimentation on an ongoing basis, rather than as an isolated a *process*. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others in their community and around the world. They actively develop their understanding of science by identifying their assumptions, using critical and logical thinking, and considering alternative explanations.

Revised Standards

The revision of the science standards was driven by two key questions:

- *What are the core scientific concepts and principles that all students need to understand in the 21st century?*
- *What should students be able to do in order to demonstrate understanding of the concepts and principles?*

In an attempt to address these questions, science taskforce members examined the scientific concepts and principles common to the National Science Education Standards, Benchmarks and Atlases for Science Literacy, and the National Assessment of Educational Progress (NAEP) Framework. This resulted in narrowing the breadth of content from 10 standards to four standards that include 17 clearly-defined key concepts and principles.

- **Science Practices** (standard 5.1) embody the idea of “knowledge in use” and include understanding scientific explanations, generating scientific evidence, reflecting on scientific knowledge, and participating productively in science. Science practices are integrated into the Cumulative Progress Indicators within each science domain in recognition that science content and processes are inextricably linked; science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge.
- Science content is presented in **Physical Science** (standard 5.2), **Life Science** (standard 5.3), and **Earth Systems** (standard 5.4). The most current research on how science is learned informed the development of learning progressions for each strand, which increase in depth of understanding as students progress through the grades.

Laboratory Science in the 21st Century

Laboratory science is a *practice* not a *place.* It is important to emphasize that standards-driven lab science courses do *not* include student manipulation or analysis of data created by a teacher as a replacement or substitute for direct interaction with the natural or designed world.

The revised standards and course descriptions emphasize the importance of students independently creating scientific arguments and explanations for observations made during investigations. Science education thereby becomes a sense-making enterprise for students in which they are systematically provided with ongoing opportunities to:

- Interact directly with the natural and designed world using tools, data-collection techniques, models, and theories of science.
- Actively participate in scientific investigations and use cognitive and manipulative skills associated with the formulation of scientific explanations.

- Use evidence, apply logic, and construct arguments for their proposed explanations.

The 2009 Science Standards implicitly and explicitly point to a more student-centered approach to instructional design that engages learners in inquiry. Inquiry, as defined in the revised standards, envisions learners who:

- Are engaged by scientifically-oriented questions.
- Prioritize evidence that addresses scientifically-oriented questions.
- Formulate explanations from that evidence to address those scientifically-oriented questions.
- Evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.
- Communicate and justify their proposed explanations.

Fundamental principles of instructional design assist students in achieving their intended learning goals through lab-science experiences that:

- Are designed with clear learning outcomes in mind.
- Are sequenced thoughtfully into the flow of classroom science instruction.
- Integrate learning of science content with learning about science practices.
- Incorporate ongoing student reflection and discussion (National Research Council, 2007).

Students' K-12 lab-science experiences should include the following:

- **Physical manipulation of authentic substances or systems:** This may include such activities as chemistry experiments, plant and animal observations, and investigations of force and motion.

- **Interaction with simulations:** In 21st-century laboratory science courses, students can work with computerized models, or simulations, that represent aspects of natural phenomena that cannot be observed directly because they are very large, very small, very slow, very fast, or very complex. Students may also model the interaction of molecules in chemistry or manipulate models of cells, animal or plant systems, wave motion, weather patterns, or geological formations using simulations.

- **Interaction with authentic data:** Students may interact with authentic data that are obtained and represented in a variety of forms. For example, they may study photographs to examine characteristics of the Moon or other heavenly bodies or analyze emission and absorption spectra in the light from stars. Data may be incorporated in films, DVDs, computer programs, or other formats.

- **Access to large databases:** In many fields of science, researchers have arranged for empirical data to be normalized and aggregated—for example, genome databases, astronomy image collections, databases of climatic events over long time periods, biological field observations.

Some students may be able to access authentic and timely scientific data using the Internet and can also manipulate and analyze authentic data in new forms of laboratory experiences (Bell, 2005).

- **Remote access to scientific instruments and observations:** When available, laboratory experiences enabled by the Internet can link students to remote instruments, such as the environmental scanning electron microscope (Thakkar et al., 2000), or allow them to control automated telescopes (Gould, 2004).

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Content Area	Science		
Standard	**5.1 Science Practices:** Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.		
Strand	**A. Understand Scientific Explanations**: Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.		
By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Who, what, when, where, why, and how questions form the basis for young learners' investigations during sensory explorations, experimentation, and focused inquiry.	5.1.P.A.1	Display curiosity about science objects, materials, activities, and longer-term investigations in progress.
4	Fundamental scientific concepts and principles and the links between them are more useful than discrete facts.	5.1.4.A.1	Demonstrate understanding of the interrelationships among fundamental concepts in the physical, life, and Earth systems sciences.
4	Connections developed between fundamental concepts are used to explain, interpret, build, and refine explanations, models, and theories.	5.1.4.A.2	Use outcomes of investigations to build and refine questions, models, and explanations.
4	Outcomes of investigations are used to build and refine questions, models, and explanations.	5.1.4.A.3	Use scientific facts, measurements, observations, and patterns in nature to build and critique scientific arguments.
8	Core scientific concepts and principles represent the conceptual basis for model-building and facilitate the generation of new and productive questions.	5.1.8.A.1	Demonstrate understanding and use interrelationships among central scientific concepts to revise explanations and to consider alternative explanations.

8	Results of observation and measurement can be used to build conceptual-based models and to search for core explanations.	5.1.8.A.2	Use mathematical, physical, and computational tools to build conceptual-based models and to pose theories.
8	Predictions and explanations are revised based on systematic observations, accurate measurements, and structured data/evidence.	5.1.8.A.3	Use scientific principles and models to frame and synthesize scientific arguments and pose theories.
12	Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.	5.1.12.A.1	Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations.
12	Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations.	5.1.12.A.2	Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories.
12	Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.	5.1.12.A.3	Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence.

Content Area	**Science**		
Standard	**5.1 Science Practices:** Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.		
Strand	**B. Generate Scientific Evidence Through Active Investigations:** Students master the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims.		
By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Observations and investigations form young learners' understandings of science concepts.	5.1.P.B.1	Observe, question, predict, and investigate materials, objects, and phenomena (e.g., using simple tools to crack a nut and look inside) during indoor and outdoor classroom activities and during any longer-term investigations.
P	Experiments and explorations provide opportunities for young learners to use science vocabulary and scientific terms.	5.1.P.B.2	Use basic science terms and topic-related science vocabulary.
P	Experiments and explorations give young learners opportunities to use science tools and technology.	5.1.P.B.3	Identify and use basic tools and technology to extend exploration in conjunction with science investigations.
4	Building and refining models and explanations requires generation and evaluation of evidence.	5.1.4.B.1	Design and follow simple plans using systematic observations to explore questions and predictions.
4	Tools and technology are used to gather, analyze, and communicate results.	5.1.4.B.2	Measure, gather, evaluate, and share evidence using tools and technologies.
4	Evidence is used to construct and defend arguments.	5.1.4.B.3	Formulate explanations from evidence.
4	Reasoning is used to support scientific conclusions.	5.1.4.B.4	Communicate and justify explanations with reasonable and logical arguments.
8	Evidence is generated and evaluated as part of building and refining models and explanations.	5.1.8.B.1	Design investigations and use scientific instrumentation to collect, analyze, and evaluate evidence as part of building and revising models and explanations.
8	Mathematics and technology are used	5.1.8.B.2	Gather, evaluate, and represent evidence using scientific tools,

	to gather, analyze, and communicate results.		technologies, and computational strategies.
8	Carefully collected evidence is used to construct and defend arguments.	5.1.8.B.3	Use qualitative and quantitative evidence to develop evidence-based arguments.
8	Scientific reasoning is used to support scientific conclusions.	5.1.8.B.4	Use quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations.
12	Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations.	5.1.12.B.1	Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data.
12	Mathematical tools and technology are used to gather, analyze, and communicate results.	5.1.12.B.2	Build, refine, and represent evidence-based models using mathematical, physical, and computational tools.
12	Empirical evidence is used to construct and defend arguments.	5.1.12.B.3	Revise predictions and explanations using evidence, and connect explanations/arguments to established scientific knowledge, models, and theories.
12	Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.	5.1.12.B.4	Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations.

Content Area	Science		
Standard	**5.1 Science Practices:** Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.		
Strand	**C. Reflect on Scientific Knowledge:** Scientific knowledge builds on itself over time.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Interacting with peers and adults to share questions and explorations about the natural world builds young learners' scientific knowledge.	5.1.P.C.1	Communicate with other children and adults to share observations, pursue questions, and make predictions and/or conclusions.
4	Scientific understanding changes over time as new evidence and updated arguments emerge.	5.1.4.C.1	Monitor and reflect on one's own knowledge regarding how ideas change over time.
4	Revisions of predictions and explanations occur when new arguments emerge that account more completely for available evidence.	5.1.4.C.2	Revise predictions or explanations on the basis of learning new information.
4	Scientific knowledge is a particular kind of knowledge with its own sources, justifications, and uncertainties.	5.1.4.C.3	Present evidence to interpret and/or predict cause-and-effect outcomes of investigations.
8	Scientific models and understandings of fundamental concepts and principles are refined as new evidence is considered.	5.1.8.C.1	Monitor one's own thinking as understandings of scientific concepts are refined.
8	Predictions and explanations are revised to account more completely for available evidence.	5.1.8.C.2	Revise predictions or explanations on the basis of discovering new evidence, learning new information, or using models.
8	Science is a practice in which an	5.1.8.C.3	Generate new and productive questions to evaluate and refine

	established body of knowledge is continually revised, refined, and extended.		core explanations.
12	Refinement of understandings, explanations, and models occurs as new evidence is incorporated.	5.1.12.C.1	Reflect on and revise understandings as new evidence emerges.
12	Data and refined models are used to revise predictions and explanations.	5.1.12.C.2	Use data representations and new models to revise predictions and explanations.
12	Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges.	5.1.12.C.3	Consider alternative theories to interpret and evaluate evidence-based arguments.

Content Area	**Science**		
Standard	**5.1 Science Practices:** Science is both a body of knowledge and an evidence-based, model-building enterprise that continually extends, refines, and revises knowledge. The four Science Practices strands encompass the knowledge and reasoning skills that students must acquire to be proficient in science.		
Strand	**D. Participate Productively in Science:** The growth of scientific knowledge involves critique and communication, which aresocial practices that are governed by a core set of values and norms.		

By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Science practices include drawing or "writing" on observation clipboards, making rubbings, or charting the growth of plants.	5.1.P.D.1	Represent observations and work through drawing, recording data, and "writing."
4	Science has unique norms for participation. These include adopting a critical stance, demonstrating a willingness to ask questions and seek help, and developing a sense of trust and skepticism.	5.1.4.D.1	Actively participate in discussions about student data, questions, and understandings.
4	In order to determine which arguments and explanations are most persuasive, communities of learners work collaboratively to pose, refine, and evaluate questions, investigations, models, and theories (e.g., scientific argumentation and representation).	5.1.4.D.2	Work collaboratively to pose, refine, and evaluate questions, investigations, models, and theories.
4	Instruments of measurement can be used to safely gather accurate information for making scientific comparisons of objects and events.	5.1.4.D.3	Demonstrate how to safely use tools, instruments, and supplies.
4	Organisms are treated humanely, responsibly, and ethically.	5.1.4.D.4	Handle and treat organisms humanely, responsibly, and ethically.

8	Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	5.1.8.D.1	Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and experiences.
8	In order to determine which arguments and explanations are most persuasive, communities of learners work collaboratively to pose, refine, and evaluate questions, investigations, models, and theories (e.g., argumentation, representation, visualization, etc.).	5.1.8.D.2	Engage in productive scientific discussion practices during conversations with peers, both face-to-face and virtually, in the context of scientific investigations and model-building.
8	Instruments of measurement can be used to safely gather accurate information for making scientific comparisons of objects and events.	5.1.8.D.3	Demonstrate how to safely use tools, instruments, and supplies.
8	Organisms are treated humanely, responsibly, and ethically.	5.1.8.D.4	Handle and treat organisms humanely, responsibly, and ethically.
12	Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	5.1.12.D.1	Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and experiences.
12	Science involves using language, both oral and written, as a tool for making thinking public.	5.1.12.D.2	Represent ideas using literal representations, such as graphs, tables, journals, concept maps, and diagrams.
12	Ensure that instruments and specimens are properly cared for and that animals, when used, are treated humanely, responsibly, and ethically.	5.1.12.D.3	Demonstrate how to use scientific tools and instruments and knowledge of how to handle animals with respect for their safety and welfare.

Content Area	**Science**		
Standard	**5.2 Physical Science:** Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.		
Strand	**A. Properties of Matter:** All objects and substances in the natural world are composed of matter. Matter has two fundamental properties: matter takes up space, and matter has inertia.		

By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Observations and investigations form a basis for young learners' understanding of the properties of matter.	5.2.P.A.1	Observe, manipulate, sort, and describe objects and materials (e.g., water, sand, clay, paint, glue, various types of blocks, collections of objects, simple household items that can be taken apart, or objects made of wood, metal, or cloth) in the classroom and outdoor environment based on size, shape, color, texture, and weight.
2	Living and nonliving things are made of parts and can be described in terms of the materials of which they are made and their physical properties.	5.2.2.A.1	Sort and describe objects based on the materials of which they are made and their physical properties.
2	Matter exists in several different states; the most commonly encountered are solids, liquids, and gases. Liquids take the shape of the part of the container they occupy. Solids retain their shape regardless of the container they occupy.	5.2.2.A. 2	Identify common objects as solids, liquids, or gases.
4	Some objects are composed of a single substance; others are composed of more than one substance.	5.2.4.A.1	Identify objects that are composed of a single substance and those that are composed of more than one substance using simple tools found in the classroom.
4	Each state of matter has unique properties (e.g., gases can be compressed, while solids and liquids cannot; the shape of a solid is independent of its container; liquids and	5.2.4.A.2	Plan and carry out an investigation to distinguish among solids, liquids, and gasses.

	gases take the shape of their containers).		
4	Objects and substances have properties, such as weight and volume, that can be measured using appropriate tools. Unknown substances can sometimes be identified by their properties.	5.2.4.A.3	Determine the weight and volume of common objects using appropriate tools.
4	Objects vary in the extent to which they absorb and reflect light and conduct heat (thermal energy) and electricity.	5.2.4.A.4	Categorize objects based on the ability to absorb or reflect light and conduct heat or electricity.
6	The volume of some objects can be determined using liquid (water) displacement.	5.2.6.A.1	Determine the volume of common objects using water displacement methods.
6	The density of an object can be determined from its volume and mass.	5.2.6.A.2	Calculate the density of objects or substances after determining volume and mass.
6	Pure substances have characteristic intrinsic properties, such as density, solubility, boiling point, and melting point, all of which are independent of the amount of the sample.	5.2.6.A.3	Determine the identity of an unknown substance using data about intrinsic properties.
8	All matter is made of atoms. Matter made of only one type of atom is called an element.	5.2.8.A.1	Explain that all matter is made of atoms, and give examples of common elements.
8	All substances are composed of one or more of approximately 100 elements.	5.2.8.A.2	Analyze and explain the implications of the statement "all substances are composed of elements."
8	Properties of solids, liquids, and gases are explained by a model of matter as composed of tiny particles (atoms) in motion.	5.2.8.A.3	Use the kinetic molecular model to predict how solids, liquids, and gases would behave under various physical circumstances, such as heating or cooling.
8	The Periodic Table organizes the elements into families of elements with similar properties.	5.2.8.A.4	Predict the physical and chemical properties of elements based on their positions on the Periodic Table.
8	Elements are a class of substances composed of a single kind of atom.	5.2.8.A.5	Identify unknown substances based on data regarding their physical and chemical properties.

	Compounds are substances that are chemically formed and have physical and chemical properties that differ from the reacting substances.		
8	Substances are classified according to their physical and chemical properties. Metals are a class of elements that exhibit physical properties, such as conductivity, and chemical properties, such as producing salts when combined with nonmetals.	5.2.8.A.6	Determine whether a substance is a metal or nonmetal through student-designed investigations.
8	Substances are classified according to their physical and chemical properties. Acids are a class of compounds that exhibit common chemical properties, including a sour taste, characteristic color changes with litmus and other acid/base indicators, and the tendency to react with bases to produce a salt and water.	5.2.8.A.7	Determine the relative acidity and reactivity of common acids, such as vinegar or cream of tartar, through a variety of student-designed investigations.
12	Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.	5.2.12.A.1	Use atomic models to predict the behaviors of atoms in interactions.
12	Differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are	5.2.12.A.2	Account for the differences in the physical properties of solids, liquids, and gases.

	arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules.		
12	In the Periodic Table, elements are arranged according to the number of protons (the atomic number). This organization illustrates commonality and patterns of physical and chemical properties among the elements.	5.2.12.A.3	Predict the placement of unknown elements on the Periodic Table based on their physical and chemical properties.
12	In a neutral atom, the positively charged nucleus is surrounded by the same number of negatively charged electrons. Atoms of an element whose nuclei have different numbers of neutrons are called isotopes.	5.2.12.A.4	Explain how the properties of isotopes, including half-lives, decay modes, and nuclear resonances, lead to useful applications of isotopes.
12	Solids, liquids, and gases may dissolve to form solutions. When combining a solute and solvent to prepare a solution, exceeding a particular concentration of solute will lead to precipitation of the solute from the solution. Dynamic equilibrium occurs in saturated solutions. Concentration of solutions can be calculated in terms of molarity, molality, and percent by mass.	5.2.12.A.5	Describe the process by which solutes dissolve in solvents.
12	Acids and bases are important in numerous chemical processes that occur around us, from industrial to biological processes, from the laboratory to the environment.	5.2.12.A.6	Relate the pH scale to the concentrations of various acids and bases.

Content Area	Science		
Standard	**5.2 Physical Science:** Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.		
Strand	**B. Changes in Matter**: Substances can undergo physical or chemical changes to form new substances. Each change involves energy.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Observations and investigations form a basis for young learners' understanding of changes in matter.	5.2.P.B.1	Explore changes in liquids and solids when substances are combined, heated, or cooled (e.g., mix sand or clay with various amounts of water; mix different colors of tempera paints; freeze and melt water and other liquids).
2	Some properties of matter can change as a result of processes such as heating and cooling. Not all materials respond the same way to these processes.	5.2.2.B.1	Generate accurate data and organize arguments to show that not all substances respond the same way when heated or cooled, using common materials, such as shortening or candle wax.
4	Many substances can be changed from one state to another by heating or cooling.	5.2.4.B.1	Predict and explain what happens when a common substance, such as shortening or candle wax, is heated to melting and then cooled to a solid.
6	When a new substance is made by combining two or more substances, it has properties that are different from the original substances.	5.2.6.B.1	Compare the properties of reactants with the properties of the products when two or more substances are combined and react chemically.
8	When substances undergo chemical change, the number and kinds of atoms in the reactants are the same as the number and kinds of atoms in the products. The mass of the reactants is the same as the mass of the products.	5.2.8.B.1	Explain, using an understanding of the concept of chemical change, why the mass of reactants and the mass of products remain constant.
8	Chemical changes can occur when two	5.2.8.B.2	Compare and contrast the physical properties of reactants with

	substances, elements, or compounds react and produce one or more different substances. The physical and chemical properties of the products are different from those of the reacting substances.		products after a chemical reaction, such as those that occur during photosynthesis and cellular respiration.
12	An atom's electron configuration, particularly of the outermost electrons, determines how the atom interacts with other atoms. Chemical bonds are the interactions between atoms that hold them together in molecules or between oppositely charged ions.	5.2.12.B.1	Model how the outermost electrons determine the reactivity of elements and the nature of the chemical bonds they tend to form.
12	A large number of important reactions involve the transfer of either electrons or hydrogen ions between reacting ions, molecules, or atoms. In other chemical reactions, atoms interact with one another by sharing electrons to create a bond.	5.2.12.B.2	Describe oxidation and reduction reactions, and give examples of oxidation and reduction reactions that have an impact on the environment, such as corrosion and the burning of fuel.
12	The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept.	5.2.12.B.3	Balance chemical equations by applying the law of conservation of mass.

Content Area	Science		
Standard	**5.2 Physical Science:** Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.		
Strand	**C. Forms of Energy:** Knowing the characteristics of familiar forms of energy, including potential and kinetic energy, is useful in coming to the understanding that, for the most part, the natural world can be explained and is predictable.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Observations and investigations form a basis for young learners' understanding of forms of energy.	5.2.P.C.1	Investigate sound, heat, and light energy (e.g., the pitch and volume of sound made by commercially made and homemade instruments, looking for shadows on the playground over time and under different weather conditions) through one or more of the senses.
2	The Sun warms the land, air, and water.	5.2.2.C.1	Compare, citing evidence, the heating of different colored objects placed in full sunlight.
2	An object can be seen when light strikes it and is reflected to a viewer's eye. If there is no light, objects cannot be seen.	5.2.2.C.2	Apply a variety of strategies to collect evidence that validates the principle that if there is no light, objects cannot be seen.
2	When light strikes substances and objects through which it cannot pass, shadows result.	5.2.2.C.3	Present evidence that represents the relationship between a light source, solid object, and the resulting shadow.
4	Heat (thermal energy), electricity, light, and sound are forms of energy.	5.2.4.C.1	Compare various forms of energy as observed in everyday life and describe their applications.
4	Heat (thermal energy) results when substances burn, when certain kinds of materials rub against each other, and when electricity flows though wires. Metals are good conductors of heat (thermal energy) and electricity. Increasing the temperature of any substance requires the addition of	5.2.4.C.2	Compare the flow of heat through metals and nonmetals by taking and analyzing measurements.

	energy.		
4	Energy can be transferred from one place to another. Heat energy is transferred from warmer things to colder things.	5.2.4.C.3	Draw and label diagrams showing several ways that energy can be transferred from one place to another.
4	Light travels in straight lines. When light travels from one substance to another (air and water), it changes direction.	5.2.4.C.4	Illustrate and explain what happens when light travels from air into water.
6	Light travels in a straight line until it interacts with an object or material. Light can be absorbed, redirected, bounced back, or allowed to pass through. The path of reflected or refracted light can be predicted.	5.2.6.C.1	Predict the path of reflected or refracted light using reflecting and refracting telescopes as examples.
6	Visible light from the Sun is made up of a mixture of all colors of light. To see an object, light emitted or reflected by that object must enter the eye.	5.2.6.C.2	Describe how to prisms can be used to demonstrate that visible light from the Sun is made up of different colors.
6	The transfer of thermal energy by conduction, convection, and radiation can produce large-scale events such as those seen in weather.	5.2.6.C.3	Relate the transfer of heat from oceans and land masses to the evolution of a hurricane.
8	A tiny fraction of the light energy from the Sun reaches Earth. Light energy from the Sun is Earth's primary source of energy, heating Earth surfaces and providing the energy that results in wind, ocean currents, and storms.	5.2.8.C.1	Structure evidence to explain the relatively high frequency of tornadoes in "Tornado Alley."
8	Energy is transferred from place to place. Light energy can be thought of as traveling in rays. Thermal energy travels via conduction and convection.	5.2.8.C.2	Model and explain current technologies used to capture solar energy for the purposes of converting it to electrical energy.
12	Gas particles move independently and	5.2.12.C.1	Use the kinetic molecular theory to describe and explain the

	are far apart relative to each other. The behavior of gases can be explained by the kinetic molecular theory. The kinetic molecular theory can be used to explain the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample. There is a natural tendency for a system to move in the direction of disorder or entropy.		properties of solids, liquids, and gases.
12	Heating increases the energy of the atoms composing elements and the molecules or ions composing compounds. As the kinetic energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a pure solid increases the vibrational energy of its atoms, molecules, or ions. When the vibrational energy of the molecules of a pure substance becomes great enough, the solid melts.	5.2.12.C.2	Account for any trends in the melting points and boiling points of various compounds.

Content Area	**Science**		
Standard	**5.2 Physical Science:** Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.		
Strand	**D. Energy Transfer and Conservation:** The conservation of energy can be demonstrated by keeping track of familiar forms of energy as they are transferred from one object to another.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
2	Batteries supply energy to produce light, sound, or heat.	5.2.2.D.1	Predict and confirm the brightness of a light, the volume of sound, or the amount of heat when given the number of batteries, or the size of batteries.
4	Electrical circuits require a complete loop through conducting materials in which an electrical current can pass.	5.2.4.D.1	Repair an electric circuit by completing a closed loop that includes wires, a battery (or batteries), and at least one other electrical component to produce observable change.
6	The flow of current in an electric circuit depends upon the components of the circuit and their arrangement, such as in series or parallel. Electricity flowing through an electrical circuit produces magnetic effects in the wires.	5.2.6.D.1	Use simple circuits involving batteries and motors to compare and predict the current flow with different circuit arrangements.
8	When energy is transferred from one system to another, the quantity of energy before transfer equals the quantity of energy after transfer. As an object falls, its potential energy decreases as its speed, and consequently its kinetic energy, increases. While an object is falling, some of the object’s kinetic energy is transferred to the medium through which it falls, setting the medium into motion and heating it.	5.2.8.D.1	Relate the kinetic and potential energies of a roller coaster at various points on its path.

8	Nuclear reactions take place in the Sun. In plants, light energy from the Sun is transferred to oxygen and carbon compounds, which in combination, have chemical potential energy (photosynthesis).	5.2.8.D.2	Describe the flow of energy from the Sun to the fuel tank of an automobile.
12	The potential energy of an object on Earth's surface is increased when the object's position is changed from one closer to Earth's surface to one farther from Earth's surface.	5.2.12.D.1	Model the relationship between the height of an object and its potential energy.
12	The driving forces of chemical reactions are energy and entropy. Chemical reactions either release energy to the environment (exothermic) or absorb energy from the environment (endothermic).	5.2.12.D.2	Describe the potential commercial applications of exothermic and endothermic reactions.
12	Nuclear reactions (fission and fusion) convert very small amounts of matter into energy.	5.2.12.D.3	Describe the products and potential applications of fission and fusion reactions.
12	Energy may be transferred from one object to another during collisions.	5.2.12.D.4	Measure quantitatively the energy transferred between objects during a collision.
12	Chemical equilibrium is a dynamic process that is significant in many systems, including biological, ecological, environmental, and geological systems. Chemical reactions occur at different rates. Factors such as temperature, mixing, concentration, particle size, and surface area affect the rates of chemical reactions.	5.2.12.D.5	Model the change in rate of a reaction by changing a factor.

Content Area	Science		
Standard	**5.2 Physical Science:** Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.		
Strand	**E. Forces and Motion**: It takes energy to change the motion of objects. The energy change is understood in terms of forces.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Observations and investigations form a basis for young learners' understanding of motion.	5.2.P.E.1	Investigate how and why things move (e.g., slide blocks, balance structures, push structures over, use ramps to explore how far and how fast different objects move or roll).
2	Objects can move in many different ways (fast and slow, in a straight line, in a circular path, zigzag, and back and forth).	5.2.2.E.1	Investigate and model the various ways that inanimate objects can move.
2	A force is a push or a pull. Pushing or pulling can move an object. The speed an object moves is related to how strongly it is pushed or pulled. When an object does not move in response to a push or a pull, it is because another push or pull (friction) is being applied by the environment.	5.2.2.E.2	Predict an object's relative speed, path, or how far it will travel using various forces and surfaces.
2	Some forces act by touching, while other forces can act without touching.	5.2.2.E.3	Distinguish a force that acts by direct contact with an object (e.g., by pushing or pulling) from a force that can act without direct contact (e.g., the attraction between a magnet and a steel paper clip).
4	Motion can be described as a change in position over a period of time.	5.2.4.E.1	Demonstrate through modeling that motion is a change in position over a period of time.
4	There is always a force involved when something starts moving or changes its	5.2.4.E.2	Identify the force that starts something moving or changes its speed or direction of motion.

	speed or direction of motion. A greater force can make an object move faster and farther.		
4	Magnets can repel or attract other magnets, but they attract all matter made of iron. Magnets can make some things move without being touched.	5.2.4.E.3	Investigate and categorize materials based on their interaction with magnets.
4	Earth pulls down on all objects with a force called gravity. Weight is a measure of how strongly an object is pulled down toward the ground by gravity. With a few exceptions, objects fall to the ground no matter where they are on Earth.	5.2.4.E.4	Investigate, construct, and generalize rules for the effect that force of gravity has on balls of different sizes and weights.
6	An object's position can be described by locating the object relative to other objects or a background. The description of an object's motion from one observer's view may be different from that reported from a different observer's view.	5.2.6.E.1	Model and explain how the description of an object's motion from one observer's view may be different from a different observer's view.
6	Magnetic, electrical, and gravitational forces can act at a distance.	5.2.6.E.2	Describe the force between two magnets as the distance between them is changed.
6	Friction is a force that acts to slow or stop the motion of objects.	5.2.6.E.3	Demonstrate and explain the frictional force acting on an object with the use of a physical model.
6	Sinking and floating can be predicted using forces that depend on the relative densities of objects and materials.	5.2.6.E.4	Predict if an object will sink or float using evidence and reasoning.
8	An object is in motion when its position is changing. The speed of an object is defined by how far it travels divided by the amount of time it took to travel that far.	5.2.8.E.1	Calculate the speed of an object when given distance and time.

8	Forces have magnitude and direction. Forces can be added. The net force on an object is the sum of all the forces acting on the object. An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion at constant velocity will continue at the same velocity unless acted on by an unbalanced force.	5.2.8.E.2	Compare the motion of an object acted on by balanced forces with the motion of an object acted on by unbalanced forces in a given specific scenario.
12	The motion of an object can be described by its position and velocity as functions of time and by its average speed and average acceleration during intervals of time.	5.2.12.E.1	Compare the calculated and measured speed, average speed, and acceleration of an object in motion, and account for differences that may exist between calculated and measured values.
12	Objects undergo different kinds of motion (translational, rotational, and vibrational).	5.2.12.E.2	Compare the translational and rotational motions of a thrown object and potential applications of this understanding.
12	The motion of an object changes only when a net force is applied.	5.2.12.E.3	Create simple models to demonstrate the benefits of seatbelts using Newton's first law of motion.
12	The magnitude of acceleration of an object depends directly on the strength of the net force, and inversely on the mass of the object. This relationship ($a=F_{net}/m$) is independent of the nature of the force.	5.2.12.E.4	Measure and describe the relationship between the force acting on an object and the resulting acceleration.

Content Area	Science		
Standard	**5.3 Life Science**: Life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.		
Strand	**A. Organization and Development**: Living organisms are composed of cellular units (structures) that carry out functions required for life. Cellular units are composed of molecules, which also carry out biological functions.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Observations and discussions about the natural world form a basis for young learners' understanding of life science.	5.3.P.A.1	Investigate and compare the basic physical characteristics of plants, humans, and other animals.
P	Observations and discussions form a basis for young learners' understanding of the similarities and differences among living and nonliving things.	5.3.P.A.2	Observe similarities and differences in the needs of various living things, and differences between living and nonliving things.
2	Living organisms: • Exchange nutrients and water with the environment. • Reproduce. • Grow and develop in a predictable manner.	5.3.2.A.1	Group living and nonliving things according to the characteristics that they share.
4	Living organisms: • Interact with and cause changes in their environment. • Exchange materials (such as gases, nutrients, water, and waste) with the environment. • Reproduce. • Grow and develop in a predictable	5.3.4.A.1	Develop and use evidence-based criteria to determine if an unfamiliar object is living or nonliving.

	manner.		
4	Essential functions required for the well-being of an organism are carried out by specialized structures in plants and animals.	5.3.4.A.2	Compare and contrast structures that have similar functions in various organisms, and explain how those functions may be carried out by structures that have different physical appearances.
4	Essential functions of the human body are carried out by specialized systems: ▪ Digestive ▪ Circulatory ▪ Respiratory ▪ Nervous ▪ Skeletal ▪ Muscular ▪ Reproductive	5.3.4.A.3	Describe the interactions of systems involved in carrying out everyday life activities.
6	Systems of the human body are interrelated and regulate the body's internal environment.	5.3.6.A.1	Model the interdependence of the human body's major systems in regulating its internal environment.
6	Essential functions of plant and animal cells are carried out by organelles.	5.3.6.A.2	Model and explain ways in which organelles work together to meet the cell's needs.
8	All organisms are composed of cell(s). In multicellular organisms, specialized cells perform specialized functions. Tissues, organs, and organ systems are composed of cells and function to serve the needs of cells for food, air, and waste removal.	5.3.8.A.1	Compare the benefits and limitations of existing as a single-celled organism and as a multicellular organism.
8	During the early development of an organism, cells differentiate and multiply to form the many specialized cells, tissues, and organs that compose the final organism. Tissues grow through cell division.	5.3.8.A.2	Relate the structures of cells, tissues, organs, and systems to their functions in supporting life.
12	Cells are made of complex molecules that consist mostly of a few elements.	5.3.12 A.1	Represent and explain the relationship between the structure and function of each class of complex molecules using a variety of

	Each class of molecules has its own building blocks and specific functions.		models.
12	Cellular processes are carried out by many different types of molecules, mostly by the group of proteins known as enzymes.	5.3.12.A.2	Demonstrate the properties and functions of enzymes by designing and carrying out an experiment.
12	Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions.	5.3.12.A.3	Predict a cell's response in a given set of environmental conditions.
12	Cells divide through the process of mitosis, resulting in daughter cells that have the same genetic composition as the original cell.	5.3.12.A.4	Distinguish between the processes of cellular growth (cell division) and development (differentiation).
12	Cell differentiation is regulated through the expression of different genes during the development of complex multicellular organisms.	5.3.12.A.5	Describe modern applications of the regulation of cell differentiation and analyze the benefits and risks (e.g., stem cells, sex determination).
12	There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs determine their relationships within body systems of an organism.	5.3.12.A.6	Describe how a disease is the result of a malfunctioning system, organ, and cell, and relate this to possible treatment interventions (e.g., diabetes, cystic fibrosis, lactose intolerance).

Content Area	**Science**		
Standard	**5.3 Life Science**: Life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.		
Strand	**B. Matter and Energy Transformations**: Food is required for energy and building cellular materials. Organisms in an ecosystem have different ways of obtaining food, and some organisms obtain their food directly from other organisms.		
By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Investigations form a young learners' understanding of how a habitat provides for an organism's energy needs.	5.3.P.B.1	Observe and describe how plants and animals obtain food from their environment, such as by observing the interactions between organisms in a natural habitat.
2	A source of energy is needed for all organisms to stay alive and grow. Both plants and animals need to take in water, and animals need to take in food. Plants need light.	5.3.2.B.1	Describe the requirements for the care of plants and animals related to meeting their energy needs.
2	Animals have various ways of obtaining food and water. Nearly all animals drink water or eat foods that contain water.	5.3.2.B.2	Compare how different animals obtain food and water.
2	Most plants have roots to get water and leaves to gather sunlight.	5.3.2.B.3	Explain that most plants get water from soil through their roots and gather light through their leaves.
4	Almost all energy (food) and matter can be traced to the Sun.	5.3.4.B.1	Identify sources of energy (food) in a variety of settings (farm, zoo, ocean, forest).
6	Plants are producers: They use the energy from light to make food (sugar) from carbon dioxide and water. Plants are used as a source of food (energy) for other organisms.	5.3.6.B.1	Describe the sources of the reactants of photosynthesis and trace the pathway to the products.
6	All animals, including humans, are	5.3.6.B.2	Illustrate the flow of energy (food) through a community.

	consumers that meet their energy needs by eating other organisms or their products.		
8	Food is broken down to provide energy for the work that cells do, and is a source of the molecular building blocks from which needed materials are assembled.	5.3.8.B.1	Relate the energy and nutritional needs of organisms in a variety of life stages and situations, including stages of development and periods of maintenance.
8	All animals, including humans, are consumers that meet their energy needs by eating other organisms or their products.	5.3.8.B.2	Analyze the components of a consumer's diet and trace them back to plants and plant products.
12	As matter cycles and energy flows through different levels of organization within living systems (cells, organs, organisms, communities), and between living systems and the physical environment, chemical elements are recombined into different products.	5.3.12.B.1	Cite evidence that the transfer and transformation of matter and energy links organisms to one another and to their physical setting.
12	Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.	5.3.12.B.2	Use mathematical formulas to justify the concept of an efficient diet.
12	Continual input of energy from sunlight keeps matter and energy flowing through ecosystems.	5.3.12.B.3	Predict what would happen to an ecosystem if an energy source was removed.
12	Plants have the capability to take energy from light to form sugar molecules containing carbon, hydrogen, and oxygen.	5.3.12.B.4	Explain how environmental factors (such as temperature, light intensity, and the amount of water available) can affect photosynthesis as an energy storing process.
12	In both plant and animal cells, sugar is a source of energy and can be used to make other carbon-containing (organic) molecules.	5.3.12.B.5	Investigate and describe the complementary relationship (cycling of matter and flow of energy) between photosynthesis and cellular respiration.
12	All organisms must break the high-	5.3.12.B.6	Explain how the process of cellular respiration is similar to the

	energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes.		burning of fossil fuels.

Content Area	Science		
Standard	**5.3 Life Science**: Life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.		
Strand	**C. Interdependence:** All animals and most plants depend on both other organisms and their environment to meet their basic needs.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Investigations and observations of the interactions between plants and animals form a basis for young learners' understanding of interdependence in life science.	5.3.P.C.1	Observe and describe how natural habitats provide for the basic needs of plants and animals with respect to shelter, food, water, air, and light (e.g., dig outside in the soil to investigate the kinds of animal life that live in and around the ground).
2	Organisms interact and are interdependent in various ways; for example, they provide food and shelter to one another.	5.3.2.C.1	Describe the ways in which organisms interact with each other and their habitats in order to meet basic needs.
2	A habitat supports the growth of many different plants and animals by meeting their basic needs of food, water, and shelter.	5.3.2.C.2	Identify the characteristics of a habitat that enable the habitat to support the growth of many different plants and animals.
2	Humans can change natural habitats in ways that can be helpful or harmful for the plants and animals that live there.	5.3.2.C.3	Communicate ways that humans protect habitats and/or improve conditions for the growth of the plants and animals that live there, or ways that humans might harm habitats.
4	Organisms can only survive in environments in which their needs are met. Within ecosystems, organisms interact with and are dependent on their physical and living environment.	5.3.4.C.1	Predict the biotic and abiotic characteristics of an unfamiliar organism's habitat.
4	Some changes in ecosystems occur	5.3.4.C.2	Explain the consequences of rapid ecosystem change (e.g.,

	slowly, while others occur rapidly. Changes can affect life forms, including humans.		flooding, wind storms, snowfall, volcanic eruptions), and compare them to consequences of gradual ecosystem change (e.g., gradual increase or decrease in daily temperatures, change in yearly rainfall).
6	Various human activities have changed the capacity of the environment to support some life forms.	5.3.6.C.1	Explain the impact of meeting human needs and wants on local and global environments.
6	The number of organisms and populations an ecosystem can support depends on the biotic resources available and on abiotic factors, such as quantities of light and water, range of temperatures, and soil composition.	5.3.6.C.2	Predict the impact that altering biotic and abiotic factors has on an ecosystem.
6	All organisms cause changes in the ecosystem in which they live. If this change reduces another organism's access to resources, that organism may move to another location or die.	5.3.6.C.3	Describe how one population of organisms may affect other plants and/or animals in an ecosystem.
8	Symbiotic interactions among organisms of different species can be classified as: • Producer/consumer • Predator/prey • Parasite/host • Scavenger/prey • Decomposer/prey	5.3.8.C.1	Model the effect of positive and negative changes in population size on a symbiotic pairing.
12	Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.	5.3.12.C.1	Analyze the interrelationships and interdependencies among different organisms, and explain how these relationships contribute to the stability of the ecosystem.
12	Stability in an ecosystem can be disrupted by natural or human interactions.	5.3.12.C.2	Model how natural and human-made changes in the environment will affect individual organisms and the dynamics of populations.

Content Area	Science		
Standard	**5.3 Life Science**: Life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.		
Strand	**D. Heredity and Reproduction:** Organisms reproduce, develop, and have predictable life cycles. Organisms contain genetic information that influences their traits, and they pass this on to their offspring during reproduction.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Observations of developmental changes in a plant or animal over time form a basis for young learners' understanding of heredity and reproduction.	5.3.P.D.1	Observe and record change over time and cycles of change that affect living things (e.g., use baby photographs to discuss human change and growth, observe and photograph tree growth and leaf changes throughout the year, monitor the life cycle of a plant).
2	Plants and animals often resemble their parents.	5.3.2.D.1	Record the observable characteristics of plants and animals to determine the similarities and differences between parents and their offspring.
2	Organisms have predictable characteristics at different stages of development.	5.3.2.D.2	Determine the characteristic changes that occur during the life cycle of plants and animals by examining a variety of species, and distinguish between growth and development.
4	Plants and animals have life cycles (they begin life, develop into adults, reproduce, and eventually die). The characteristics of each stage of life vary by species.	5.3.4.D.1	Compare the physical characteristics of the different stages of the life cycle of an individual organism, and compare the characteristics of life stages among species.
6	Reproduction is essential to the continuation of every species.	5.3.6.D.1	Predict the long-term effect of interference with normal patterns of reproduction.
6	Variations exist among organisms of the same generation (e.g., siblings) and of different generations (e.g., parent to	5.3.6.D.2	Explain how knowledge of inherited variations within and between generations is applied to farming and animal breeding.

	offspring).		
6	Traits such as eye color in human beings or fruit/flower color in plants are inherited.	5.3.6.D.3	Distinguish between inherited and acquired traits/characteristics.
8	Some organisms reproduce asexually. In these organisms, all genetic information comes from a single parent. Some organisms reproduce sexually, through which half of the genetic information comes from each parent.	5.3.8.D.1	Defend the principle that, through reproduction, genetic traits are passed from one generation to the next, using evidence collected from observations of inherited traits.
8	The unique combination of genetic material from each parent in sexually reproducing organisms results in the potential for variation.	5.3.8.D.2	Explain the source of variation among siblings.
8	Characteristics of organisms are influenced by heredity and/or their environment.	5.3.8.D.3	Describe the environmental conditions or factors that may lead to a change in a cell's genetic information or to an organism's development, and how these changes are passed on.
12	Genes are segments of DNA molecules located in the chromosome of each cell. DNA molecules contain information that determines a sequence of amino acids, which result in specific proteins.	5.3.12.D.1	Explain the value and potential applications of genome projects.
12	Inserting, deleting, or substituting DNA segments can alter the genetic code. An altered gene may be passed on to every cell that develops from it. The resulting features may help, harm, or have little or no effect on the offspring's success in its environment.	5.3.12.D.2	Predict the potential impact on an organism (no impact, significant impact) given a change in a specific DNA code, and provide specific real world examples of conditions caused by mutations.
12	Sorting and recombination of genes in sexual reproduction result in a great variety of possible gene combinations in the offspring of any two parents.	5.3.12.D.3	Demonstrate through modeling how the sorting and recombination of genes during sexual reproduction has an effect on variation in offspring (meiosis, fertilization).

Content Area	Science		
Standard	**5.3 Life Science**: Life science principles are powerful conceptual tools for making sense of the complexity, diversity, and interconnectedness of life on Earth. Order in natural systems arises in accordance with rules that govern the physical world, and the order of natural systems can be modeled and predicted through the use of mathematics.		
Strand	**E. Evolution and Diversity**: Sometimes, differences between organisms of the same kind provide advantages for surviving and reproducing in different environments. These selective differences may lead to dramatic changes in characteristics of organisms in a population over extremely long periods of time.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
2	Variations exist within a group of the same kind of organism.	5.3.2.E.1	Describe similarities and differences in observable traits between parents and offspring.
2	Plants and animals have features that help them survive in different environments.	5.3.2.E.2	Describe how similar structures found in different organisms (e.g., eyes, ears, mouths) have similar functions and enable those organisms to survive in different environments.
4	Individuals of the same species may differ in their characteristics, and sometimes these differences give individuals an advantage in surviving and reproducing in different environments.	5.3.4.E.1	Model an adaptation to a species that would increase its chances of survival, should the environment become wetter, dryer, warmer, or colder over time.
4	In any ecosystem, some populations of organisms thrive and grow, some decline, and others do not survive at all.	5.3.4.E.2	Evaluate similar populations in an ecosystem with regard to their ability to thrive and grow.
6	Changes in environmental conditions can affect the survival of individual organisms and entire species.	5.3.6.E.1	Describe the impact on the survival of species during specific times in geologic history when environmental conditions changed.
8	Individual organisms with certain traits are more likely than others to survive and have offspring in particular environments. The advantages or	5.3.8.E.1	Organize and present evidence to show how the extinction of a species is related to an inability to adapt to changing environmental conditions using quantitative and qualitative data.

	disadvantages of specific characteristics can change when the environment in which they exist changes. Extinction of a species occurs when the environment changes and the characteristics of a species are insufficient to allow survival.		
8	Anatomical evidence supports evolution and provides additional detail about the sequence of branching of various lines of descent.	5.3.8.E.2	Compare the anatomical structures of a living species with fossil records to derive a line of descent.
12	New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.	5.3.12.E.1	Account for the appearance of a novel trait that arose in a given population.
12	Molecular evidence (e.g., DNA, protein structures, etc.) substantiates the anatomical evidence for evolution and provides additional detail about the sequence in which various lines of descent branched.	5.3.12.E.2	Estimate how closely related species are, based on scientific evidence (e.g., anatomical similarities, similarities of DNA base and/or amino acid sequence).
12	The principles of evolution (including natural selection and common descent) provide a scientific explanation for the history of life on Earth as evidenced in the fossil record and in the similarities that exist within the diversity of existing organisms.	5.3.12.E.3	Provide a scientific explanation for the history of life on Earth using scientific evidence (e.g., fossil record, DNA, protein structures, etc.).
12	Evolution occurs as a result of a combination of the following factors: • Ability of a species to reproduce • Genetic variability of offspring due to mutation and recombination of genes • Finite supply of the resources required for life	5.3.12.E.4	Account for the evolution of a species by citing specific evidence of biological mechanisms.

	• Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring		

Content Area	Science		
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.		
Strand	**A. Objects in the Universe:** Our universe has been expanding and evolving for 13.7 billion years under the influence of gravitational and nuclear forces. As gravity governs its expansion, organizational patterns, and the movement of celestial bodies, nuclear forces within stars govern its evolution through the processes of stellar birth and death. These same processes governed the formation of our solar system 4.6 billion years ago.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
2	The Sun is a star that can only be seen during the day. The Moon is not a star and can be seen sometimes at night and sometimes during the day. The Moon appears to have different shapes on different days.	5.4.2.A.1	Determine a set of general rules describing when the Sun and Moon are visible based on actual sky observations.
4	Objects in the sky have patterns of movement. The Sun and Moon appear to move across the sky on a daily basis. The shadows of an object on Earth change over the course of a day, indicating the changing position of the Sun during the day.	5.4.4.A.1	Formulate a general description of the daily motion of the Sun across the sky based on shadow observations. Explain how shadows could be used to tell the time of day.
4	The observable shape of the Moon changes from day to day in a cycle that lasts 29.5 days.	5.4.4.A.2	Identify patterns of the Moon's appearance and make predictions about its future appearance based observational data.
4	Earth is approximately spherical in shape. Objects fall towards the center of the Earth because of the pull of the force of gravity.	5.4.4.A.3	Generate a model with explanatory value that explains both why objects roll down ramps as well as why the Moon orbits Earth.
4	Earth is the third planet from the Sun in our solar system, which includes seven	5.4.4.A.4	Analyze and evaluate evidence in the form of data tables and photographs to categorize and relate solar system objects (e.g.,

	other planets.		planets, dwarf planets, moons, asteroids, and comets).
6	The height of the path of the Sun in the sky and the length of a shadow change over the course of a year.	5.4.6.A.1	Generate and analyze evidence (through simulations) that the Sun's apparent motion across the sky changes over the course of a year.
6	Earth's position relative to the Sun, and the rotation of Earth on its axis, result in patterns and cycles that define time units of days and years.	5.4.6.A.2	Construct and evaluate models demonstrating the rotation of Earth on its axis and the orbit of Earth around the Sun.
6	The Sun's gravity holds planets and other objects in the solar system in orbit, and planets' gravity holds moons in orbit.	5.4.6.A.3	Predict what would happen to an orbiting object if gravity were increased, decreased, or taken away.
6	The Sun is the central and most massive body in our solar system, which includes eight planets and their moons, dwarf planets, asteroids, and comets.	5.4.6.A.4	Compare and contrast the major physical characteristics (including size and scale) of solar system objects using evidence in the form of data tables and photographs.
8	The relative positions and motions of the Sun, Earth, and Moon result in the phases of the Moon, eclipses, and the daily and monthly cycle of tides.	5.4.8.A.1	Analyze moon-phase, eclipse, and tidal data to construct models that explain how the relative positions and motions of the Sun, Earth, and Moon cause these three phenomena.
8	Earth's tilt, rotation, and revolution around the Sun cause changes in the height and duration of the Sun in the sky. These factors combine to explain the changes in the length of the day and seasons.	5.4.8.A.2	Use evidence of global variations in day length, temperature, and the amount of solar radiation striking Earth's surface to create models that explain these phenomena and seasons.
8	Gravitation is a universal attractive force by which objects with mass attract one another. The gravitational force between two objects is proportional to their masses and inversely proportional to the square of the distance between the objects.	5.4.8.A.3	Predict how the gravitational force between two bodies would differ for bodies of different masses or bodies that are different distances apart.
8	The regular and predictable motion of	5.4.8.A.4	Analyze data regarding the motion of comets, planets, and

	objects in the solar system (Kepler's Laws) is explained by gravitational forces.		moons to find general patterns of orbital motion.
12	Prior to the work of 17th-century astronomers, scientists believed the Earth was the center of the universe (geocentric model).	5.4.12.A.1	Explain how new evidence obtained using telescopes (e.g., the phases of Venus or the moons of Jupiter) allowed 17th-century astronomers to displace the geocentric model of the universe.
12	The properties and characteristics of solar system objects, combined with radioactive dating of meteorites and lunar samples, provide evidence that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.	5.4.12.A.2	Collect, analyze, and critique evidence that supports the theory that Earth and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.
12	Stars experience significant changes during their life cycles, which can be illustrated with an Hertzsprung-Russell (H-R) Diagram.	5.4.12.A.3	Analyze an H-R diagram and explain the life cycle of stars of different masses using simple stellar models.
12	The Sun is one of an estimated two hundred billion stars in our Milky Way galaxy, which together with over one hundred billion other galaxies, make up the universe.	5.4.12.A.4	Analyze simulated and/or real data to estimate the number of stars in our galaxy and the number of galaxies in our universe.
12	The Big Bang theory places the origin of the universe at approximately 13.7 billion years ago. Shortly after the Big Bang, matter (primarily hydrogen and helium) began to coalesce to form galaxies and stars.	5.4.12.A.5	Critique evidence for the theory that the universe evolved as it expanded from a single point 13.7 billion years ago.
12	According to the Big Bang theory, the universe has been expanding since its beginning, explaining the apparent movement of galaxies away from one another.	5.4.12.A.6	Argue, citing evidence (e.g., Hubble Diagram), the theory of an expanding universe.

Content Area	Science		
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.		
Strand	**B. History of Earth:** From the time that Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical, and chemical processes.		

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
4	Fossils provide evidence about the plants and animals that lived long ago, including whether they lived on the land or in the sea as well as ways species changed over time.	5.4.4.B.1	Use data gathered from observations of fossils to argue whether a given fossil is terrestrial or marine in origin.
6	Successive layers of sedimentary rock and the fossils contained in them tell the factual story of the age, history, changing life forms, and geology of Earth.	5.4.6.B.1	Interpret a representation of a rock layer sequence to establish oldest and youngest layers, geologic events, and changing life forms.
6	Earth's current structure has been influenced by both sporadic and gradual events. Changes caused by earthquakes and volcanic eruptions can be observed on a human time scale, but many geological processes, such as mountain building and the shifting of continents, are observed on a geologic time scale.	5.4.6.B.2	Examine Earth's surface features and identify those created on a scale of human life or on a geologic time scale.
6	Moving water, wind, and ice continually shape Earth's surface by eroding rock and soil in some areas and depositing them in other areas.	5.4.6.B.3	Determine if landforms were created by processes of erosion (e.g., wind, water, and/or ice) based on evidence in pictures, video, and/or maps.
6	Erosion plays an important role in the	5.4.6.B.4	Describe methods people use to reduce soil erosion.

	formation of soil, but too much erosion can wash away fertile soil from ecosystems, including farms.		
8	Today's planet is very different than early Earth. Evidence for one-celled forms of life (bacteria) extends back more than 3.5 billion years.	5.4.8.B.1	Correlate the evolution of organisms and the environmental conditions on Earth as they changed throughout geologic time.
8	Fossils provide evidence of how life and environmental conditions have changed. The principle of Uniformitarianism makes possible the interpretation of Earth's history. The same Earth processes that occurred in the past occur today.	5.4.8.B.2	Evaluate the appropriateness of increasing the human population in a region (e.g., barrier islands, Pacific Northwest, Midwest United States) based on the region's history of catastrophic events, such as volcanic eruptions, earthquakes, and floods.
12	The evolution of life caused dramatic changes in the composition of Earth's atmosphere, which did not originally contain oxygen gas.	5.4.12.B.1	Trace the evolution of our atmosphere and relate the changes in rock types and life forms to the evolving atmosphere.
12	Relative dating uses index fossils and stratigraphic sequences to determine the sequence of geologic events.	5.4.12.B.2	Correlate stratigraphic columns from various locations by using index fossils and other dating techniques.
12	Absolute dating, using radioactive isotopes in rocks, makes it possible to determine how many years ago a given rock sample formed.	5.4.12.B.3	Account for the evolution of species by citing specific absolute-dating evidence of fossil samples.

Content Area	**Science**
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.
Strand	**C. Properties of Earth Materials:** Earth's composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life.

By the end of grade	Content Statement	CPI #	Cumulative Progress Indicator (CPI)
P	Observations and investigations form a basis for young learners' understanding of properties of Earth materials.	5.4.P.C.1	Explore and describe characteristics of and concepts about soil, rocks, water, and air.
2	Soils are made of many living and nonliving substances. The attributes and properties of soil (e.g., moisture, kind and size of particles, living/organic elements, etc.) vary depending on location.	5.4.2.C.1	Describe Earth materials using appropriate terms, such as hard, soft, dry, wet, heavy, and light.
4	Rocks can be broken down to make soil.	5.4.4.C.1	Create a model to represent how soil is formed.
4	Earth materials in nature include rocks, minerals, soils, water, and the gases of the atmosphere. Attributes of rocks and minerals assist in their identification.	5.4.4.C.2	Categorize unknown samples as either rocks or minerals.
6	Soil attributes/properties affect the soil's ability to support animal life and grow plants.	5.4.6.C.1	Predict the types of ecosystems that unknown soil samples could support based on soil properties.
6	The rock cycle is a model of creation and transformation of rocks from one form (sedimentary, igneous, or metamorphic) to another. Rock families are determined by the origin and transformations of the rock.	5.4.6.C.2	Distinguish physical properties of sedimentary, igneous, or metamorphic rocks and explain how one kind of rock could eventually become a different kind of rock.
6	Rocks and rock formations contain	5.4.6.C.3	Deduce the story of the tectonic conditions and erosion forces

	evidence that tell a story about their past. The story is dependent on the minerals, materials, tectonic conditions, and erosion forces that created them.		that created sample rocks or rock formations.
8	Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers, each having a different chemical composition and texture.	5.4.8.C.1	Determine the chemical properties of soil samples in order to select an appropriate location for a community garden.
8	Physical and chemical changes take place in Earth materials when Earth features are modified through weathering and erosion.	5.4.8.C.2	Explain how chemical and physical mechanisms (changes) are responsible for creating a variety of landforms.
8	Earth's atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has a different physical and chemical composition at different elevations.	5.4.8.C.3	Model the vertical structure of the atmosphere using information from active and passive remote-sensing tools (e.g., satellites, balloons, and/or ground-based sensors) in the analysis.
12	Soils are at the interface of the Earth systems, linking together the biosphere, geosphere, atmosphere, and hydrosphere.	5.4.12.C.1	Model the interrelationships among the spheres in the Earth systems by creating a flow chart.
12	The chemical and physical properties of the vertical structure of the atmosphere support life on Earth.	5.4.12.C.2	Analyze the vertical structure of Earth's atmosphere, and account for the global, regional, and local variations of these characteristics and their impact on life.

Content Area	Science		
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.		
Strand	**D. Tectonics:** The theory of plate tectonics provides a framework for understanding the dynamic processes within and on Earth.		
By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
6	Lithospheric plates consisting of continents and ocean floors move in response to movements in the mantle.	5.4.6.D.1	Apply understanding of the motion of lithospheric plates to explain why the Pacific Rim is referred to as the Ring of Fire.
6	Earth's landforms are created through constructive (deposition) and destructive (erosion) processes.	5.4.6.D.2	Locate areas that are being created (deposition) and destroyed (erosion) using maps and satellite images.
6	Earth has a magnetic field that is detectable at the surface with a compass.	5.4.6.D.3	Apply knowledge of Earth's magnetic fields to successfully complete an orienteering challenge.
8	Earth is layered with a lithosphere, a hot, convecting mantle, and a dense, metallic core.	5.4.8.D.1	Model the interactions between the layers of Earth.
8	Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from the motion of plates. Sea floor spreading, revealed in mapping of the Mid-Atlantic Ridge, and subduction zones are evidence for the theory of plate tectonics.	5.4.8.D.2	Present evidence to support arguments for the theory of plate motion.
8	Earth's magnetic field has north and south poles and lines of force that are used for navigation.	5.4.8.D.3	Explain why geomagnetic north and geographic north are at different locations.
12	Convection currents in the upper mantle drive plate motion. Plates are pushed	5.4.12.D.1	Explain the mechanisms for plate motions using earthquake data, mathematics, and conceptual models.

	apart at spreading zones and pulled down into the crust at subduction zones.		
12	Evidence from lava flows and ocean-floor rocks shows that Earth's magnetic field reverses (North – South) over geologic time.	5.4.12.D.2	Calculate the average rate of seafloor spreading using archived geomagnetic-reversals data.

Content Area	**Science**		
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.		
Strand	**E. Energy in Earth Systems:** Internal and external sources of energy drive Earth systems.		
By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Observations and investigations form the basis for young learners' understanding of energy in Earth systems.	5.4.P.E.1	Explore the effects of sunlight on living and nonliving things.
2	Plants need sunlight to grow.	5.4.2.E.1	Describe the relationship between the Sun and plant growth.
4	Land, air, and water absorb the Sun's energy at different rates.	5.4.4.E.1	Develop a general set of rules to predict temperature changes of Earth materials, such as water, soil, and sand, when placed in the Sun and in the shade.
6	The Sun is the major source of energy for circulating the atmosphere and oceans.	5.4.6.E.1	Generate a conclusion about energy transfer and circulation by observing a model of convection currents.
8	The Sun provides energy for plants to grow and drives convection within the atmosphere and oceans, producing winds, ocean currents, and the water cycle.	5.4.8.E.1	Explain how energy from the Sun is transformed or transferred in global wind circulation, ocean circulation, and the water cycle.
12	The Sun is the major external source of energy for Earth's global energy budget.	5.4.12.E.1	Model and explain the physical science principles that account for the global energy budget.
12	Earth systems have internal and external sources of energy, both of which create heat.	5.4.12.E.2	Predict what the impact on biogeochemical systems would be if there were an increase or decrease in internal and external energy.

Content Area	Science		
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.		
Strand	**F. Climate and Weather:** Earth's weather and climate systems are the result of complex interactions between land, ocean, ice, and atmosphere.		
By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Observations and investigations form the basis for young learners' understanding of weather and climate.	5.4.P.F.1	Observe and record weather.
2	Current weather conditions include air movement, clouds, and precipitation. Weather conditions affect our daily lives.	5.4.2.F.1	Observe and document daily weather conditions and discuss how the weather influences your activities for the day.
4	Weather changes that occur from day to day and across the seasons can be measured and documented using basic instruments such as a thermometer, wind vane, anemometer, and rain gauge.	5.4.4.F.1	Identify patterns in data collected from basic weather instruments.
6	Weather is the result of short-term variations in temperature, humidity, and air pressure.	5.4.6.F.1	Explain the interrelationships between daily temperature, air pressure, and relative humidity data.
6	Climate is the result of long-term patterns of temperature and precipitation.	5.4.6.F.2	Create climatographs for various locations around Earth and categorize the climate based on the yearly patterns of temperature and precipitation.
8	Global patterns of atmospheric movement influence local weather.	5.4.8.F.1	Determine the origin of local weather by exploring national and international weather maps.
8	Climate is influenced locally and globally by atmospheric interactions with land masses and bodies of water.	5.4.8.F.2	Explain the mechanisms that cause varying daily temperature ranges in a coastal community and in a community located in the interior of the country.
8	Weather (in the short term) and climate	5.4.8.F.3	Create a model of the hydrologic cycle that focuses on the

	(in the long term) involve the transfer of energy and water in and out of the atmosphere.		transfer of water in and out of the atmosphere. Apply the model to different climates around the world.
12	Global climate differences result from the uneven heating of Earth's surface by the Sun. Seasonal climate variations are due to the tilt of Earth's axis with respect to the plane of Earth's nearly circular orbit around the Sun.	5.4.12.F.1	Explain that it is warmer in summer and colder in winter for people in New Jersey because the intensity of sunlight is greater and the days are longer in summer than in winter. Connect these seasonal changes in sunlight to the tilt of Earth's axis with respect to the plane of its orbit around the Sun.
12	Climate is determined by energy transfer from the Sun at and near Earth's surface. This energy transfer is influenced by dynamic processes, such as cloud cover and Earth's rotation, as well as static conditions, such as proximity to mountain ranges and the ocean. Human activities, such as the burning of fossil fuels, also affect the global climate.	5.4.12.F.2	Explain how the climate in regions throughout the world is affected by seasonal weather patterns, as well as other factors, such as the addition of greenhouse gases to the atmosphere and proximity to mountain ranges and to the ocean.
12	Earth's radiation budget varies globally, but is balanced. Earth's hydrologic cycle is complex and varies globally, regionally, and locally.	5.4.12.F.3	Explain variations in the global energy budget and hydrologic cycle at the local, regional, and global scales.

Content Area	**Science**
Standard	**5.4 Earth Systems Science**: Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.
Strand	**G. Biogeochemical Cycles**: The biogeochemical cycles in the Earth systems include the flow of microscopic and macroscopic resources from one reservoir in the hydrosphere, geosphere, atmosphere, or biosphere to another, are driven by Earth's internal and external sources of energy, and are impacted by human activity.

By the end of grade	**Content Statement**	**CPI #**	**Cumulative Progress Indicator (CPI)**
P	Investigations in environmental awareness activities form a basis for young learners' understanding of biogeochemical changes.	5.4.P.G.1	Demonstrate emergent awareness for conservation, recycling, and respect for the environment (e.g., turning off water faucets, using paper from a classroom scrap box when whole sheets are not needed, keeping the playground neat and clean).
2	Water can disappear (evaporate) and collect (condense) on surfaces.	5.4.2.G.1	Observe and discuss evaporation and condensation.
2	There are many sources and uses of water.	5.4.2.G.2	Identify and use water conservation practices.
2	Organisms have basic needs and they meet those needs within their environment.	5.4.2.G.3	Identify and categorize the basic needs of living organisms as they relate to the environment.
2	The origin of everyday manufactured products such as paper and cans can be traced back to natural resources.	5.4.2.G.4	Identify the natural resources used in the process of making various manufactured products.
4	Clouds and fog are made of tiny droplets of water and, at times, tiny particles of ice.	5.4.4.G.1	Explain how clouds form.
4	Rain, snow, and other forms of precipitation come from clouds; not all clouds produce precipitation.	5.4.4.G.2	Observe daily cloud patterns, types of precipitation, and temperature, and categorize the clouds by the conditions that form precipitation.
4	Most of Earth's surface is covered by water. Water circulates through the	5.4.4.G.3	Trace a path a drop of water might follow through the water cycle.

	crust, oceans, and atmosphere in what is known as the water cycle.		
4	Properties of water depend on where the water is located (oceans, rivers, lakes, underground sources, and glaciers).	5.4.4.G.4	Model how the properties of water can change as water moves through the water cycle.
6	Circulation of water in marine environments is dependent on factors such as the composition of water masses and energy from the Sun or wind.	5.4.6.G.1	Illustrate global winds and surface currents through the creation of a world map of global winds and currents that explains the relationship between the two factors.
6	An ecosystem includes all of the plant and animal populations and nonliving resources in a given area. Organisms interact with each other and with other components of an ecosystem.	5.4.6.G.2	Create a model of ecosystems in two different locations, and compare and contrast the living and nonliving components.
6	Personal activities impact the local and global environment.	5.4.6.G.3	Describe ways that humans can improve the health of ecosystems around the world.
8	Water in the oceans holds a large amount of heat, and therefore significantly affects the global climate system.	5.4.8.G.1	Represent and explain, using sea surface temperature maps, how ocean currents impact the climate of coastal communities.
8	Investigations of environmental issues address underlying scientific causes and may inform possible solutions.	5.4.8.G.2	Investigate a local or global environmental issue by defining the problem, researching possible causative factors, understanding the underlying science, and evaluating the benefits and risks of alternative solutions.
12	Natural and human-made chemicals circulate with water in the hydrologic cycle.	5.4.12.G.1	Analyze and explain the sources and impact of a specific industry on a large body of water (e.g., Delaware or Chesapeake Bay).
12	Natural ecosystems provide an array of basic functions that affect humans. These functions include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients.	5.4.12.G.2	Explain the unintended consequences of harvesting natural resources from an ecosystem.

12	Movement of matter through Earth’s system is driven by Earth’s internal and external sources of energy and results in changes in the physical and chemical properties of the matter.	5.4.12.G.3	Demonstrate, using models, how internal and external sources of energy drive the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles.
12	Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.	5.4.12.G.4	Compare over time the impact of human activity on the cycling of matter and energy through ecosystems.
12	Human activities have changed Earth’s land, oceans, and atmosphere, as well as its populations of plant and animal species.	5.4.12.G.5	Assess (using maps, local planning documents, and historical records) how the natural environment has changed since humans have inhabited the region.
12	Scientific, economic, and other data can assist in assessing environmental risks and benefits associated with societal activity.	5.4.12.G.6	Assess (using scientific, economic, and other data) the potential environmental impact of large-scale adoption of emerging technologies (e.g., wind farming, harnessing geothermal energy).
12	Earth is a system in which chemical elements exist in fixed amounts and move through the solid Earth, oceans, atmosphere, and living things as part of geochemical cycles.	5.4.12.G.7	Relate information to detailed models of the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles, identifying major sources, sinks, fluxes, and residence times.