# Next Generation Sunshine State Standards

## Science

## 9-12

Found 15standards.

**Life Science**

Standard 14: Organization and Development of Living Organisms

1. Cells have characteristic structures and functions that make them distinctive.
2. Processes in a cell can be classified broadly as growth, maintenance, reproduction, and homeostasis.
3. Life can be organized in a functional and structural hierarchy ranging from cells to the biosphere.
4. Most multicellular organisms are composed of organ systems whose structures reflect their particular function.

(SC.912.L.14)

Benchmark: 1. Describe the scientific theory of cells (cell theory) and relate the history of its discovery to the process of science. (SC.912.L.14.1)

Benchmark: 2. Relate structure to function for the components of plant and animal cells. Explain the role of cell membranes as a highly selective barrier (passive and active transport). (SC.912.L.14.2)

Benchmark: 3. Compare and contrast the general structures of plant and animal cells. Compare and contrast the general structures of prokaryotic and eukaryotic cells. (SC.912.L.14.3)

Benchmark: 4. Compare and contrast structure and function of various types of microscopes. (SC.912.L.14.4)

Benchmark: 5. Explain the evidence supporting the scientific theory of the origin of eukaryotic cells (endosymbiosis). (SC.912.L.14.5)

Benchmark: 6. Explain the significance of genetic factors, environmental factors, and pathogenic agents to health from the perspectives of both individual and public health. (SC.912.L.14.6)

Benchmark: 7. Relate the structure of each of the major plant organs and tissues to physiological processes. (SC.912.L.14.7)

Benchmark: 8. Explain alternation of generations in plants. (SC.912.L.14.8)

Benchmark: 9. Relate the major structure of fungi to their functions. (SC.912.L.14.9)

Benchmark: 10. Discuss the relationship between the evolution of land plants and their anatomy. (SC.912.L.14.10)

Benchmark: 11. Classify and state the defining characteristics of epithelial tissue, connective tissue, muscle tissue, and nervous tissue. (SC.912.L.14.11)

Benchmark: 12. Describe the anatomy and histology of bone tissue. (SC.912.L.14.12)

Benchmark: 13. Distinguish between bones of the axial skeleton and the appendicular skeleton. (SC.912.L.14.13)

Benchmark: 14. Identify the major bones of the axial and appendicular skeleton. (SC.912.L.14.14)

Benchmark: 15. Identify major markings (such as foramina, fossae, tubercles, etc.) on a skeleton. Explain why these markings are important. (SC.912.L.14.15)

Benchmark: 16. Describe the anatomy and histology, including ultrastructure, of muscle tissue. (SC.912.L.14.16)

Benchmark: 17. List the steps involved in the sliding filament of muscle contraction. (SC.912.L.14.17)

Benchmark: 18. Describe signal transmission across a myoneural junction. (SC.912.L.14.18)

Benchmark: 19. Explain the physiology of skeletal muscle. (SC.912.L.14.19)

Benchmark: 20. Identify the major muscles of the human on a model or diagram. (SC.912.L.14.20)

Benchmark: 21. Describe the anatomy, histology, and physiology of the central and peripheral nervous systems and name the major divisions of the nervous system. (SC.912.L.14.21)

Benchmark: 22. Describe the physiology of nerve conduction, including the generator potential, action potential, and the synapse. (SC.912.L.14.22)

Benchmark: 23. Identify the parts of a reflex arc. (SC.912.L.14.23)

Benchmark: 24. Identify the general parts of a synapse and describe the physiology of signal transmission across a synapse. (SC.912.L.14.24)

Benchmark: 25. Identify the major parts of a cross section through the spinal cord. (SC.912.L.14.25)

Benchmark: 26. Identify the major parts of the brain on diagrams or models. (SC.912.L.14.26)

Benchmark: 27. Identify the functions of the major parts of the brain, including the meninges, medulla, pons, midbrain, hypothalamus, thalamus, cerebellum and cerebrum. (SC.912.L.14.27)

Benchmark: 28. Identify the major functions of the spinal cord. (SC.912.L.14.28)

Benchmark: 29. Define the terms endocrine and exocrine. (SC.912.L.14.29)

Benchmark: 30. Compare endocrine and neural controls of physiology. (SC.912.L.14.30)

Benchmark: 31. Describe the physiology of hormones including the different types and the mechanisms of their action. (SC.912.L.14.31)

Benchmark: 32. Describe the anatomy and physiology of the endocrine system. (SC.912.L.14.32)

Benchmark: 33. Describe the basic anatomy and physiology of the reproductive system. (SC.912.L.14.33)

Benchmark: 34. Describe the composition and physiology of blood, including that of the plasma and the formed elements. (SC.912.L.14.34)

Benchmark: 35. Describe the steps in hemostasis, including the mechanism of coagulation. Include the basis for blood typing and transfusion reactions. (SC.912.L.14.35)

Benchmark: 36. Describe the factors affecting blood flow through the cardiovascular system. (SC.912.L.14.36)

Benchmark: 37. Explain the components of an electrocardiogram. (SC.912.L.14.37)

Benchmark: 38. Describe normal heart sounds and what they mean. (SC.912.L.14.38)

Benchmark: 39. Describe hypertension and some of the factors that produce it. (SC.912.L.14.39)

Benchmark: 40. Describe the histology of the major arteries and veins of systemic, pulmonary, hepatic portal, and coronary circulation. (SC.912.L.14.40)

Benchmark: 41. Describe fetal circulation and changes that occur to the circulatory system at birth. (SC.912.L.14.41)

Benchmark: 42. Describe the anatomy and the physiology of the lymph system. (SC.912.L.14.42)

Benchmark: 43. Describe the histology of the respiratory system. (SC.912.L.14.43)

Benchmark: 44. Describe the physiology of the respiratory system including the mechanisms of ventilation, gas exchange, gas transport and the mechanisms that control the rate of ventilation. (SC.912.L.14.44)

Benchmark: 45. Describe the histology of the alimentary canal and its associated accessory organs. (SC.912.L.14.45)

Benchmark: 46. Describe the physiology of the digestive system, including mechanical digestion, chemical digestion, absorption and the neural and hormonal mechanisms of control. (SC.912.L.14.46)

Benchmark: 47. Describe the physiology of urine formation by the kidney. (SC.912.L.14.47)

Benchmark: 48. Describe the anatomy, histology, and physiology of the ureters, the urinary bladder and the urethra. (SC.912.L.14.48)

Benchmark: 49. Identify the major functions associated with the sympathetic and parasympathetic nervous systems. (SC.912.L.14.49)

Benchmark: 50. Describe the structure of vertebrate sensory organs. Relate structure to function in vertebrate sensory systems. (SC.912.L.14.50)

Benchmark: 51. Describe the function of the vertebrate integumentary system. (SC.912.L.14.51)

Benchmark: 52. Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics. (SC.912.L.14.52)

Benchmark: 53. Discuss basic classification and characteristics of plants. Identify bryophytes, pteridophytes, gymnosperms, and angiosperms. (SC.912.L.14.53)

Standard 15: Diversity and Evolution of Living Organisms

1. The scientific theory of evolution is the fundamental concept underlying all of biology.
2. The scientific theory of evolution is supported by multiple forms of scientific evidence.
3. Organisms are classified based on their evolutionary history.
4. Natural selection is a primary mechanism leading to evolutionary change.

(SC.912.L.15)

Benchmark: 1. Explain how the scientific theory of evolution is supported by the fossil record, comparative anatomy, comparative embryology, biogeography, molecular biology, and observed evolutionary change. (SC.912.L.15.1)

Benchmark: 2. Discuss the use of molecular clocks to estimate how long ago various groups of organisms diverged evolutionarily from one another. (SC.912.L.15.2)

Benchmark: 3. Describe how biological diversity is increased by the origin of new species and how it is decreased by the natural process of extinction. (SC.912.L.15.3)

Benchmark: 4. Describe how and why organisms are hierarchically classified and based on evolutionary relationships. (SC.912.L.15.4)

Benchmark: 5. Explain the reasons for changes in how organisms are classified. (SC.912.L.15.5)

Benchmark: 6. Discuss distinguishing characteristics of the domains and kingdoms of living organisms. (SC.912.L.15.6)

Benchmark: 7. Discuss distinguishing characteristics of vertebrate and representative invertebrate phyla, and chordate classes using typical examples. (SC.912.L.15.7)

Benchmark: 8. Describe the scientific explanations of the origin of life on Earth. (SC.912.L.15.8)

Benchmark: 9. Explain the role of reproductive isolation in the process of speciation. (SC.912.L.15.9)

Benchmark: 10. Identify basic trends in hominid evolution from early ancestors six million years ago to modern humans, including brain size, jaw size, language, and manufacture of tools. (SC.912.L.15.10)

Benchmark: 11. Discuss specific fossil hominids and what they show about human evolution. (SC.912.L.15.11)

Benchmark: 12. List the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature. Use the Hardy-Weinberg equation to predict genotypes in a population from observed phenotypes. (SC.912.L.15.12)

Benchmark: 13. Describe the conditions required for natural selection, including: overproduction of offspring, inherited variation, and the struggle to survive, which result in differential reproductive success. (SC.912.L.15.13)

Benchmark: 14. Discuss mechanisms of evolutionary change other than natural selection such as genetic drift and gene flow. (SC.912.L.15.14)

Benchmark: 15. Describe how mutation and genetic recombination increase genetic variation. (SC.912.L.15.15)

Standard 16: Heredity and Reproduction

1. DNA stores and transmits genetic information. Genes are sets of instructions encoded in the structure of DNA.
2. Genetic information is passed from generation to generation by DNA in all organisms and accounts for similarities in related individuals.
3. Manipulation of DNA in organisms has led to commercial production of biological molecules on a large scale and genetically modified organisms.
4. Reproduction is characteristic of living things and is essential for the survival of species.

(SC.912.L.16)

Benchmark: 1. Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance. (SC.912.L.16.1)

Benchmark: 2. Discuss observed inheritance patterns caused by various modes of inheritance, including dominant, recessive, codominant, sex-linked, polygenic, and multiple alleles. (SC.912.L.16.2)

Benchmark: 3. Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information. (SC.912.L.16.3)

Benchmark: 4. Explain how mutations in the DNA sequence may or may not result in phenotypic change. Explain how mutations in gametes may result in phenotypic changes in offspring. (SC.912.L.16.4)

Benchmark: 5. Explain the basic processes of transcription and translation, and how they result in the expression of genes. (SC.912.L.16.5)

Benchmark: 6. Discuss the mechanisms for regulation of gene expression in prokaryotes and eukaryotes at transcription and translation level. (SC.912.L.16.6)

Benchmark: 7. Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology. (SC.912.L.16.7)

Benchmark: 8. Explain the relationship between mutation, cell cycle, and uncontrolled cell growth potentially resulting in cancer. (SC.912.L.16.8)

Benchmark: 9. Explain how and why the genetic code is universal and is common to almost all organisms. (SC.912.L.16.9)

Benchmark: 10. Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues. (SC.912.L.16.10)

Benchmark: 11. Discuss the technologies associated with forensic medicine and DNA identification, including restriction fragment length polymorphism (RFLP) analysis. (SC.912.L.16.11)

Benchmark: 12. Describe how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, polymerase chain reaction, ligation, and transformation) is used to construct recombinant DNA molecules (DNA cloning). (SC.912.L.16.12)

Benchmark: 13. Describe the basic anatomy and physiology of the human reproductive system. Describe the process of human development from fertilization to birth and major changes that occur in each trimester of pregnancy. (SC.912.L.16.13)

Benchmark: 14. Describe the cell cycle, including the process of mitosis. Explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction. (SC.912.L.16.14)

Benchmark: 15. Compare and contrast binary fission and mitotic cell division. (SC.912.L.16.15)

Benchmark: 16. Describe the process of meiosis, including independent assortment and crossing over. Explain how reduction division results in the formation of haploid gametes or spores. (SC.912.L.16.16)

Benchmark: 17. Compare and contrast mitosis and meiosis and relate to the processes of sexual and asexual reproduction and their consequences for genetic variation. (SC.912.L.16.17)

Standard 17: Interdependence

1. The distribution and abundance of organisms is determined by the interactions between organisms, and between organisms and the non-living environment.
2. Energy and nutrients move within and between biotic and abiotic components of ecosystems via physical, chemical and biological processes.
3. Human activities and natural events can have profound effects on populations, biodiversity and ecosystem processes.

(SC.912.L.17)

Benchmark: 1. Discuss the characteristics of populations, such as number of individuals, age structure, density, and pattern of distribution. (SC.912.L.17.1)

Benchmark: 2. Explain the general distribution of life in aquatic systems as a function of chemistry, geography, light, depth, salinity, and temperature. (SC.912.L.17.2)

Benchmark: 3. Discuss how various oceanic and freshwater processes, such as currents, tides, and waves, affect the abundance of aquatic organisms. (SC.912.L.17.3)

Benchmark: 4. Describe changes in ecosystems resulting from seasonal variations, climate change and succession. (SC.912.L.17.4)

Benchmark: 5. Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity. (SC.912.L.17.5)

Benchmark: 6. Compare and contrast the relationships among organisms, including predation, parasitism, competition, commensalism, and mutualism. (SC.912.L.17.6)

Benchmark: 7. Characterize the biotic and abiotic components that define freshwater systems, marine systems and terrestrial systems. (SC.912.L.17.7)

Benchmark: 8. Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species. (SC.912.L.17.8)

Benchmark: 9. Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels. (SC.912.L.17.9)

Benchmark: 10. Diagram and explain the biogeochemical cycles of an ecosystem, including water, carbon, and nitrogen cycle. (SC.912.L.17.10)

Benchmark: 11. Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests. (SC.912.L.17.11)

Benchmark: 12. Discuss the political, social, and environmental consequences of sustainable use of land. (SC.912.L.17.12)

Benchmark: 13. Discuss the need for adequate monitoring of environmental parameters when making policy decisions. (SC.912.L.17.13)

Benchmark: 14. Assess the need for adequate waste management strategies. (SC.912.L.17.14)

Benchmark: 15. Discuss the effects of technology on environmental quality. (SC.912.L.17.15)

Benchmark: 16. Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution. (SC.912.L.17.16)

Benchmark: 17. Assess the effectiveness of innovative methods of protecting the environment. (SC.912.L.17.17)

Benchmark: 18. Describe how human population size and resource use relate to environmental quality. (SC.912.L.17.18)

Benchmark: 19. Describe how different natural resources are produced and how their rates of use and renewal limit availability. (SC.912.L.17.19)

Benchmark: 20. Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability. (SC.912.L.17.20)

Standard 18: Matter and Energy Transformations

1. All living things are composed of four basic categories of macromolecules and share the same basic needs for life.
2. Living organisms acquire the energy they need for life processes through various metabolic pathways (primarily photosynthesis and cellular respiration).
3. Chemical reactions in living things follow basic rules of chemistry and are usually regulated by enzymes.
4. The unique chemical properties of carbon and water make life on Earth possible.

(SC.912.L.18)

Benchmark: 1. Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules. (SC.912.L.18.1)

Benchmark: 2. Describe the important structural characteristics of monosaccharides, disaccharides, and polysaccharides and explain the functions of carbohydrates in living things. (SC.912.L.18.2)

Benchmark: 3. Describe the structures of fatty acids, triglycerides, phospholipids, and steroids. Explain the functions of lipids in living organisms. Identify some reactions that fatty acids undergo. Relate the structure and function of cell membranes. (SC.912.L.18.3)

Benchmark: 4. Describe the structures of proteins and amino acids. Explain the functions of proteins in living organisms. Identify some reactions that amino acids undergo. Relate the structure and function of enzymes. (SC.912.L.18.4)

Benchmark: 5. Discuss the use of chemiosmotic gradients for ATP production in chloroplasts and mitochondria. (SC.912.L.18.5)

Benchmark: 6. Discuss the role of anaerobic respiration in living things and in human society. (SC.912.L.18.6)

Benchmark: 7. Identify the reactants, products, and basic functions of photosynthesis. (SC.912.L.18.7)

Benchmark: 8. Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration. (SC.912.L.18.8)

Benchmark: 9. Explain the interrelated nature of photosynthesis and cellular respiration. (SC.912.L.18.9)

Benchmark: 10. Connect the role of adenosine triphosphate (ATP) to energy transfers within a cell. (SC.912.L.18.10)

Benchmark: 11. Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, and their effect on enzyme activity. (SC.912.L.18.11)

Benchmark: 12. Discuss the special properties of water that contribute to Earth's suitability as an environment for life: cohesive behavior, ability to moderate temperature, expansion upon freezing, and versatility as a solvent. (SC.912.L.18.12)

**Physical Science**

Standard 8: Matter

1. A working definition of matter is that it takes up space, has mass, and has measurable properties. Matter is comprised of atomic, subatomic, and elementary particles.
2. Electrons are key to defining chemical and some physical properties, reactivity, and molecular structures. Repeating (periodic) patterns of physical and chemical properties occur among elements that define groups of elements with similar properties. The periodic table displays the repeating patterns, which are related to the atom's outermost electrons. Atoms bond with each other to form compounds.
3. In a chemical reaction, one or more reactants are transformed into one or more new products. Many factors shape the nature of products and the rates of reaction.
4. Carbon-based compounds are building-blocks of known life forms on earth and numerous useful natural and synthetic products.

(SC.912.P.8)

Benchmark: 1. Differentiate among the four states of matter. (SC.912.P.8.1)

Benchmark: 2. Differentiate between physical and chemical properties and physical and chemical changes of matter. (SC.912.P.8.2)

Benchmark: 3. Explore the scientific theory of atoms (also known as atomic theory) by describing changes in the atomic model over time and why those changes were necessitated by experimental evidence. (SC.912.P.8.3)

Benchmark: 4. Explore the scientific theory of atoms (also known as atomic theory) by describing the structure of atoms in terms of protons, neutrons and electrons, and differentiate among these particles in terms of their mass, electrical charges and locations within the atom. (SC.912.P.8.4)

Benchmark: 5. Relate properties of atoms and their position in the periodic table to the arrangement of their electrons. (SC.912.P.8.5)

Benchmark: 6. Distinguish between bonding forces holding compounds together and other attractive forces, including hydrogen bonding and van der Waals forces. (SC.912.P.8.6)

Benchmark: 7. Interpret formula representations of molecules and compounds in terms of composition and structure. (SC.912.P.8.7)

Benchmark: 8. Characterize types of chemical reactions, for example: redox, acid-base, synthesis, and single and double replacement reactions. (SC.912.P.8.8)

Benchmark: 9. Apply the mole concept and the law of conservation of mass to calculate quantities of chemicals participating in reactions. (SC.912.P.8.9)

Benchmark: 10. Describe oxidation-reduction reactions in living and non-living systems. (SC.912.P.8.10)

Benchmark: 11. Relate acidity and basicity to hydronium and hydroxyl ion concentration and pH. (SC.912.P.8.11)

Benchmark: 12. Describe the properties of the carbon atom that make the diversity of carbon compounds possible. (SC.912.P.8.12)

Benchmark: 13. Identify selected functional groups and relate how they contribute to properties of carbon compounds. (SC.912.P.8.13)

Standard 10: Energy

1. Energy is involved in all physical and chemical processes. It is conserved, and can be transformed from one form to another and into work. At the atomic and nuclear levels energy is not continuous but exists in discrete amounts. Energy and mass are related through Einstein's equation E=mc2.
2. The properties of atomic nuclei are responsible for energy-related phenomena such as radioactivity, fission and fusion.
3. In a chemical reaction, one or more reactants are transformed into one or more new products. Many factors shape the nature of products and the rates of reaction.

Changes in entropy and energy that accompany chemical reactions influence reaction paths. Chemical reactions result in the release or absorption of energy.

(SC.912.P.10)

Benchmark: 1. Differentiate among the various forms of energy and recognize that they can be transformed from one form to others. (SC.912.P.10.1)

Benchmark: 2. Explore the Law of Conservation of Energy by differentiating among open, closed, and isolated systems and explain that the total energy in an isolated system is a conserved quantity. (SC.912.P.10.2)

Benchmark: 3. Compare and contrast work and power qualitatively and quantitatively. (SC.912.P.10.3)

Benchmark: 4. Describe heat as the energy transferred by convection, conduction, and radiation, and explain the connection of heat to change in temperature or states of matter. (SC.912.P.10.4)

Benchmark: 5. Relate temperature to the average molecular kinetic energy. (SC.912.P.10.5)

Benchmark: 6. Create and interpret potential energy diagrams, for example: chemical reactions, orbits around a central body, motion of a pendulum. (SC.912.P.10.6)

Benchmark: 7. Distinguish between endothermic and exothermic chemical processes. (SC.912.P.10.7)

Benchmark: 8. Explain entropy's role in determining the efficiency of processes that convert energy to work. (SC.912.P.10.8)

Benchmark: 9. Describe the quantization of energy at the atomic level. (SC.912.P.10.9)

Benchmark: 10. Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, strong nuclear). (SC.912.P.10.10)

Benchmark: 11. Explain and compare nuclear reactions (radioactive decay, fission and fusion), the energy changes associated with them and their associated safety issues. (SC.912.P.10.11)

Benchmark: 12. Differentiate between chemical and nuclear reactions. (SC.912.P.10.12)

Benchmark: 13. Relate the configuration of static charges to the electric field, electric force, electric potential, and electric potential energy. (SC.912.P.10.13)

Benchmark: 14. Differentiate among conductors, semiconductors, and insulators. (SC.912.P.10.14)

Benchmark: 15. Investigate and explain the relationships among current, voltage, resistance, and power. (SC.912.P.10.15)

Benchmark: 16. Explain the relationship between moving charges and magnetic fields, as well as changing magnetic fields and electric fields, and their application to modern technologies. (SC.912.P.10.16)

Benchmark: 17. Explore the theory of electromagnetism by explaining electromagnetic waves in terms of oscillating electric and magnetic fields. (SC.912.P.10.17)

Benchmark: 18. Explore the theory of electromagnetism by comparing and contrasting the different parts of the electromagnetic spectrum in terms of wavelength, frequency, and energy, and relate them to phenomena and applications. (SC.912.P.10.18)

Benchmark: 19. Explain that all objects emit and absorb electromagnetic radiation and distinguish between objects that are blackbody radiators and those that are not. (SC.912.P.10.19)

Benchmark: 20. Describe the measurable properties of waves and explain the relationships among them and how these properties change when the wave moves from one medium to another. (SC.912.P.10.20)

Benchmark: 21. Qualitatively describe the shift in frequency in sound or electromagnetic waves due to the relative motion of a source or a receiver. (SC.912.P.10.21)

Benchmark: 22. Construct ray diagrams and use thin lens and mirror equations to locate the images formed by lenses and mirrors. (SC.912.P.10.22)

Standard 12: Motion

1. Motion can be measured and described qualitatively and quantitatively. Net forces create a change in motion. When objects travel at speeds comparable to the speed of light, Einstein's special theory of relativity applies.
2. Momentum is conserved under well-defined conditions. A change in momentum occurs when a net force is applied to an object over a time interval.
3. The Law of Universal Gravitation states that gravitational forces act on all objects irrespective of their size and position.
4. Gases consist of great numbers of molecules moving in all directions. The behavior of gases can be modeled by the kinetic molecular theory.
5. Chemical reaction rates change with conditions under which they occur. Chemical equilibrium is a dynamic state in which forward and reverse processes occur at the same rates.

(SC.912.P.12)

Benchmark: 1. Distinguish between scalar and vector quantities and assess which should be used to describe an event. (SC.912.P.12.1)

Benchmark: 2. Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time. (SC.912.P.12.2)

Benchmark: 3. Interpret and apply Newton's three laws of motion. (SC.912.P.12.3)

Benchmark: 4. Describe how the gravitational force between two objects depends on their masses and the distance between them. (SC.912.P.12.4)

Benchmark: 5. Apply the law of conservation of linear momentum to interactions, such as collisions between objects. (SC.912.P.12.5)

Benchmark: 6. Qualitatively apply the concept of angular momentum. (SC.912.P.12.6)

Benchmark: 7. Recognize that nothing travels faster than the speed of light in vacuum which is the same for all observers no matter how they or the light source are moving. (SC.912.P.12.7)

Benchmark: 8. Recognize that Newton's Laws are a limiting case of Einstein's Special Theory of Relativity at speeds that are much smaller than the speed of light. (SC.912.P.12.8)

Benchmark: 9. Recognize that time, length, and energy depend on the frame of reference. (SC.912.P.12.9)

Benchmark: 10. Interpret the behavior of ideal gases in terms of kinetic molecular theory. (SC.912.P.12.10)

Benchmark: 11. Describe phase transitions in terms of kinetic molecular theory. (SC.912.P.12.11)

Benchmark: 12. Explain how various factors, such as concentration, temperature, and presence of a catalyst affect the rate of a chemical reaction. (SC.912.P.12.12)

Benchmark: 13. Explain the concept of dynamic equilibrium in terms of reversible processes occurring at the same rates. (SC.912.P.12.13)

**Earth and Space Science**

Standard 5: Earth in Space and Time  
The origin and eventual fate of the Universe still remains one of the greatest questions in science. Gravity and energy influence the development and life cycles of galaxies, including our own Milky Way Galaxy, stars, the planetary systems, Earth, and residual material left from the formation of the Solar System. Humankind (SC.912.E.5.)

Benchmark: 1. Cite evidence used to develop and verify the scientific theory of the Big Bang (also known as the Big Bang Theory) of the origin of the universe. (SC.912.E.5.1)

Benchmark: 2. Identify patterns in the organization and distribution of matter in the universe and the forces that determine them. (SC.912.E.5.2)

Benchmark: 3. Describe and predict how the initial mass of a star determines its evolution. (SC.912.E.5.3)

Benchmark: 4. Explain the physical properties of the Sun and its dynamic nature and connect them to conditions and events on Earth. (SC.912.E.5.4)

Benchmark: 5. Explain the formation of planetary systems based on our knowledge of our Solar System and apply this knowledge to newly discovered planetary systems. (SC.912.E.5.5)

Benchmark: 6. Develop logical connections through physical principles, including Kepler's and Newton's Laws about the relationships and the effects of Earth, Moon, and Sun on each other. (SC.912.E.5.6)

Benchmark: 7. Relate the history of and explain the justification for future space exploration and continuing technology development. (SC.912.E.5.7)

Benchmark: 8. Connect the concepts of radiation and the electromagnetic spectrum to the use of historical and newly-developed observational tools. (SC.912.E.5.8)

Benchmark: 9. Analyze the broad effects of space exploration on the economy and culture of Florida. (SC.912.E.5.9)

Benchmark: 10. Describe and apply the coordinate system used to locate objects in the sky. (SC.912.E.5.10)

Benchmark: 11. Distinguish the various methods of measuring astronomical distances and apply each in appropriate situations. (SC.912.E.5.11)

Standard 6: Earth Structures  
The scientific theory of plate tectonics provides the framework for much of modern geology. Over geologic time, internal and external sources of energy have continuously altered the features of Earth by means of both constructive and destructive forces. All life, including human civilization, is dependent on Earth's internal and external energy and material resources. (SC.912.E.6)

Benchmark: 1. Describe and differentiate the layers of Earth and the interactions among them. (SC.912.E.6.1)

Benchmark: 2. Connect surface features to surface processes that are responsible for their formation. (SC.912.E.6.2)

Benchmark: 3. Analyze the scientific theory of plate tectonics and identify related major processes and features as a result of moving plates. (SC.912.E.6.3)

Benchmark: 4. Analyze how specific geologic processes and features are expressed in Florida and elsewhere. (SC.912.E.6.4)

Benchmark: 5. Describe the geologic development of the present day oceans and identify commonly found features. (SC.912.E.6.5)

Benchmark: 6. Analyze past, present, and potential future consequences to the environment resulting from various energy production technologies. (SC.912.E.6.6)

Standard 7: Earth Systems and Patterns  
The scientific theory of the evolution of Earth states that changes in our planet are driven by the flow of energy and the cycling of matter through dynamic interactions among the atmosphere, hydrosphere, cryosphere, geosphere, and biosphere, and the resources used to sustain human civilization on Earth. (SC.912.E.7)

Benchmark: 1. Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon. (SC.912.E.7.1)

Benchmark: 2. Analyze the causes of the various kinds of surface and deep water motion within the oceans and their impacts on the transfer of energy between the poles and the equator. (SC.912.E.7.2)

Benchmark: 3. Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere. (SC.912.E.7.3)

Benchmark: 4. Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans. (SC.912.E.7.4)

Benchmark: 5. Predict future weather conditions based on present observations and conceptual models and recognize limitations and uncertainties of such predictions. (SC.912.E.7.5)

Benchmark: 6. Relate the formation of severe weather to the various physical factors. (SC.912.E.7.6)

Benchmark: 7. Identify, analyze, and relate the internal (Earth system) and external (astronomical) conditions that contribute to global climate change.   
(SC.912.E.7.7)

Benchmark: 8. Explain how various atmospheric, oceanic, and hydrologic conditions in Florida have influenced and can influence human behavior, both individually and collectively. (SC.912.E.7.8)

Benchmark: 9. Cite evidence that the ocean has had a significant influence on climate change by absorbing, storing, and moving heat, carbon, and water.   
(SC.912.E.7.9)

**Nature of Science**

Standard 1: The Practice of Science

1. Scientific inquiry is a multifaceted activity; The processes of science include the formulation of scientifically investigable questions, construction of investigations into those questions, the collection of appropriate data, the evaluation of the meaning of those data, and the communication of this evaluation.
2. The processes of science frequently do not correspond to the traditional portrayal of "the scientific method."
3. Scientific argumentation is a necessary part of scientific inquiry and plays an important role in the generation and validation of scientific knowledge.
4. Scientific knowledge is based on observation and inference; it is important to recognize that these are very different things. Not only does science require creativity in its methods and processes, but also in its questions and explanations.

(SC.912.N.1)

Benchmark: 1. Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:

1. pose questions about the natural world,
2. conduct systematic observations,
3. examine books and other sources of information to see what is already known,
4. review what is known in light of empirical evidence,
5. plan investigations,
6. use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs),
7. pose answers, explanations, or descriptions of events,
8. generate explanations that explicate or describe natural phenomena (inferences),
9. use appropriate evidence and reasoning to justify these explanations to others,
10. communicate results of scientific investigations, and
11. evaluate the merits of the explanations produced by others.

(SC.912.N.1.1)

Benchmark: 2. Describe and explain what characterizes science and its methods. (SC.912.N.1.2)

Benchmark: 3. Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented. (SC.912.N.1.3)

Benchmark: 4. Identify sources of information and assess their reliability according to the strict standards of scientific investigation. (SC.912.N.1.4)

Benchmark: 5. Describe and provide examples of how similar investigations conducted in many parts of the world result in the same outcome. (SC.912.N.1.5)

Benchmark: 6. Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied. (SC.912.N.1.6)

Benchmark: 7. Recognize the role of creativity in constructing scientific questions, methods and explanations. (SC.912.N.1.7)

Standard 2: The Characteristics of Scientific Knowledge

1. Scientific knowledge is based on empirical evidence, and is appropriate for understanding the natural world, but it provides only a limited understanding of the supernatural, aesthetic, or other ways of knowing, such as art, philosophy, or religion.
2. Scientific knowledge is durable and robust, but open to change.
3. Because science is based on empirical evidence it strives for objectivity, but as it is a human endeavor the processes, methods, and knowledge of science include subjectivity, as well as creativity and discovery.

(SC.912.N.2)

Benchmark: 1. Identify what is science, what clearly is not science, and what superficially resembles science (but fails to meet the criteria for science). (SC.912.N.2.1)

Benchmark: 2. Identify which questions can be answered through science and which questions are outside the boundaries of scientific investigation, such as questions addressed by other ways of knowing, such as art, philosophy, and religion. (SC.912.N.2.2)

Benchmark: 3. Identify examples of pseudoscience (such as astrology, phrenology) in society. (SC.912.N.2.3)

Benchmark: 4. Explain that scientific knowledge is both durable and robust and open to change. Scientific knowledge can change because it is often examined and re-examined by new investigations and scientific argumentation. Because of these frequent examinations, scientific knowledge becomes stronger, leading to its durability. (SC.912.N.2.4)

Benchmark: 5. Describe instances in which scientists' varied backgrounds, talents, interests, and goals influence the inferences and thus the explanations that they make about observations of natural phenomena and describe that competing interpretations (explanations) of scientists are a strength of science as they are a source of new, testable ideas that have the potential to add new evidence to support one or another of the explanations. (SC.912.N.2.5)

Standard 3: The Role of Theories, Laws, Hypotheses, and Models  
The terms that describe examples of scientific knowledge, for example: "theory," "law," "hypothesis" and "model" have very specific meanings and functions within science. (SC.912.N.3)

Benchmark: 1. Explain that a scientific theory is the culmination of many scientific investigations drawing together all the current evidence concerning a substantial range of phenomena; thus, a scientific theory represents the most powerful explanation scientists have to offer. (SC.912.N.3.1)

Benchmark: 2. Describe the role consensus plays in the historical development of a theory in any one of the disciplines of science. (SC.912.N.3.2)

Benchmark: 3. Explain that scientific laws are descriptions of specific relationships under given conditions in nature, but do not offer explanations for those relationships. (SC.912.N.3.3)

Benchmark: 4. Recognize that theories do not become laws, nor do laws become theories; theories are well supported explanations and laws are well supported descriptions. (SC.912.N.3.4)

Benchmark: 5. Describe the function of models in science, and identify the wide range of models used in science. (SC.912.N.3.5)

Standard 4: Science and Society  
As tomorrows citizens, students should be able to identify issues about which society could provide input, formulate scientifically investigable questions about those issues, construct investigations of their questions, collect and evaluate data from their investigations, and develop scientific recommendations based upon their findings. (SC.912.N.4)

Benchmark: 1. Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making. (SC.912.N.4.1)

Benchmark: 2. Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental. (SC.912.N.4.2)