Grade 7 Science
Standards, Benchmarks, and Indicators

Standard LS.1 – PLAN AND CONDUCT INVESTIGATIONS

► Reporting Category: Scientific Investigation

LS.1 A  The student will construct and interpret data tables.
1. Construct and interpret a data table that includes space to organize all components of an investigation in a meaningful way, including levels of the independent variable, responses measured of the dependent variable, number of trials, and mathematical means.

2. Generate lists, tables, or charts to classify, group, or order objects or events according to observations and/or similarities or differences in properties.

LS.1 B  The student will define variables.
See LS.1 F 1

LS.1 C  The student will select appropriate tools to accurately measure using, and making conversions, among metric units.
1. Utilize correct tools and techniques for collecting qualitative and quantitative data.
   b. Recognize metric prefix units for length, temperature, and liquid volume and make common conversions within the same metric base unit applying appropriate prefixes.
   c. Record measurements accurately (i.e., estimate to one more decimal place).

2. Use principles of mathematics to collect and analyze data.

LS.1 D  The student will construct models to illustrate and explain phenomena.
1. Create mental, verbal, or physical models/representations of ideas, objects, or events to visualize and clarify explanations or demonstrate relationships (e.g., tables, charts, graphs, drawings, three-dimensional models, etc.).

LS.1 E  The student will identify sources of experimental error.
1. Evaluate the design of an experiment and the events that occur during an investigation to determine which factors may affect the results of the experiment.
   a. Suggest possible sources of experimental error; generate and evaluate possible solutions.
   b. Suggest improvements in the design of an experiment.
LS.1 F  **The student will identify the key components of a controlled experiment.**
1. Identify the key components of a controlled experiment: hypothesis, independent and dependent variables, constants, control, and repeated trials.
   - The independent (manipulated) variable is deliberately changed in the experiment and the dependent (responding) variable is measured.
   - Constants are the variables in an experiment which must not change in order for the investigation to represent a fair test.
2. Distinguish between observational and experimental investigations.

LS.1 G  **The student will manipulate the key components of a controlled experiment.**
1. Design and conduct scientific investigations to test a hypothesis to obtain reliable data by applying the generalized steps of experimental methodology (formerly FCPS Standard 4).
   a. State the problem or question.
   b. Formulate hypotheses based on evidence that can be tested through experimentation.
   c. Make predictions based on prior knowledge, understandings, observations and inferences.
   d. Develop and follow a clear and logical procedure to test a hypothesis.
   e. Identify and control variables to investigate the outcome of an event while other factors are held constant.
   f. Use the senses to make qualitative and/or quantitative observations to gather and record information about observations and measurements in a systematic way.
2. Apply science knowledge, skills, and technology resources to gather information, solve problems, and make informed decisions (formerly FCPS Standard 2).
   - Content-specific software
   - Web tools and simulations
   - Graphing calculators and data collection probes
LS.1 H  The student will construct and interpret the appropriate type of graph for a given set of data.
   1. Construct and/or interpret the appropriate type of graph for a given set of data.
      • Frequency distributions (i.e., histogram and line plot)
      • Bar graph
      • Line graph
      • Circle graph (pie graph)
   2. Demonstrate graphing skills by identifying and properly labeling the x- and y-axes; creating a title and key; and accurately plotting data points.
   3. Use a variety of means, including computer technology, to collect, organize, interpret, analyze, and synthesize data using tables, graphs, and diagrams to locate patterns and trends that lead to the construction of inferences, predictions, or hypotheses.

LS.1 I  The student will formulate valid conclusions after analyzing data and observations.
   1. Formulate conclusions that are supported by the gathered data.
      a. Make inferences, predictions, or interpretations.
      b. Recognize cause and effect relationships.
      c. Determine patterns, trends, and relationships in data.
      d. Develop/support explanations, hypotheses, and models based on evidence.
   2. Calculate and display descriptive statistics showing measures of central tendency for a given set of data (number of trials, mean, median, mode, and range).
   3. Create a definition by describing what is done and/or observed.
The student will develop and reinforce an understanding of the nature of science.

1. Make connections between what is studied and the Unifying Concepts and Processes in Science.
   - Systems, order, and organization
   - Evidence, models, and explanation
   - Change, constancy, and measurements
   - Evolution and equilibrium
   - Form and function

2. Apply an understanding of the nature and methodology of scientific inquiry.
   a. Understand that scientific inquiry follows a specific methodology: begin with a question, design an investigation, gather evidence, formulate an answer to the original question, and communicate the investigative process and results.
   b. Make connections between a science discovery and its historical importance.
   c. Explain and provide examples that demonstrate that present day scientific understanding is based on the observations and investigations of previous scientists and that scientific ideas change over time (e.g., Leeuwenhoek, Mendel, Linnaeus, Watson, Crick, and Darwin).
   d. Describe how creativity comes into play during various stages of scientific investigations.

3. Make connections within science disciplines and with other disciplines (formerly FCPS Standard 5).

4. Cite examples that illustrate the interdependence of science and technology in the life sciences.

5. Apply science concepts to everyday personal experiences.


The student will use chemicals and equipment safely.

1. Follow guidelines for the safe handling and use of chemicals and equipment.
FS.1 L The student will gather, evaluate, and summarize information using multiple and variable resources.
1. Gather, evaluate, and summarize information using multiple and variable resources distinguishing between relevant and irrelevant information.
2. Detect bias from a given source.

FS.1 M The student will present experimental results in appropriate written form.
1. Communicate scientific information effectively in several formats through a variety of resources (formerly FCPS Standard 3).
   a. Use the written and spoken word, graphs, demonstrations, drawings, diagrams, or tables to transmit information and ideas to others.
   b. Communicate the purpose/problem of investigations, procedures, materials, data and/or observations, graphs, and an interpretation of results that are supported by the gathered data.
   c. Compare and contrast science concepts or events.
2. Use technology tools to design and develop presentations which effectively communicate questions, procedures, results, and conclusions of a scientific investigation.

FS.1 N The student will use research methods to investigate practical problems and questions.
1. Select appropriate strategies/procedures to investigate practical problems or questions.
2. Apply research skills to acquire, analyze, evaluate, and summarize information using multiple and variable resources (i.e., written, oral, and visual).
   a. Read and understand scientific concepts, procedures, and applications in textbooks, nonfiction science books, newspaper articles, periodicals, and other references.
   b. Interpret written, pictorial, and graphical representations.
3. Use search strategies to retrieve electronic information from a variety of sources (Internet, electronic encyclopedias, almanacs, indexes, spreadsheets, electronic databases and catalogs) and evaluate the information for its accuracy, relevance, and appropriateness.
Standard LS.2 – LIVING THINGS ARE COMPOSED OF CELLS

► Reporting Category: Life Systems

LS.2 A The student will investigate and understand cell structure and organelles.
1. Distinguish among the following: cell membrane, cytoplasm, nucleus, cell wall, vacuole, mitochondrion, endoplasmic reticulum, and chloroplast.

2. Correlate cell organelles with their roles and explain how each organelle performs its particular function within the cell.

LS.2 B The student will investigate and understand the similarities and differences between plant and animal cells.
1. Compare and contrast examples of plant and animal cells using the light microscope and images obtained from microscopes.
   a. Note similarities and differences between types of organelles found in plant cells with those found in animal cells.
   b. Relate the shape or structure of an animal or plant cell to its location and/or function in the organism.

2. Analyze and critique the experimental design of basic investigations related to animal and plant cells.

LS.2 C The student will sequence and understand the main points of the cell theory.
1. Describe and sequence the major points in the development of the cell theory.
   a. Connect the discoveries of notable scientists to the development of the cell theory (i.e., Hooke and Leeuwenhoek).
   b. Understand the role of the improvement of the microscope and microscopic techniques throughout the last four centuries in the development of the cell theory.

2. Identify the three components of the cell theory:
   • All living things are made of cells.
   • Cells are the smallest unit (structure) of living things that can perform the processes (functions) necessary for life.
   • Living cells come only from other living cells.
L.S.2 D  The student will differentiate between the purpose of mitosis and meiosis.
1. Understand that mitosis is essential for the purposes of growth, development, and repair.
   a. Locate chromosomes within the cell.
   b. Understand the importance of DNA replication for the process of mitosis.
   c. Identify and/or describe each stage of the cell cycle: interphase, mitosis (prophase, metaphase, anaphase, and telophase), and cytokinesis.
   d. Predict the number of chromosomes in the daughter cells after mitosis.

2. Recognize that meiosis is necessary for sexual reproduction and genetic variation.
   a. Predict the number of chromosomes in the daughter cells after meiosis.
Standard LS.3 – CELLULAR ORGANIZATION AND LIFE PROCESSES

► Reporting Category: Life Systems

LS.3 A The student will investigate and understand that living things show patterns of cellular organization.

1. Differentiate between unicellular organisms and multicellular organisms and name common examples of each.

2. Compare and contrast how unicellular and multicellular organisms perform various life functions.
   a. Apply knowledge about systems in multicellular organisms.

3. Identify and/or describe the different types of cells likely found in a multicellular organism and explain how their characteristics relate to specialized functions (e.g., muscle cell, nerve cell, blood cell, palisade cell, etc.).

4. Define and/or differentiate among cells, tissues, organs, and organs systems; arrange them in hierarchical order.

5. Analyze and critique the experimental design of basic investigations related to the understanding of the cellular organization with emphasis on observations of cells and tissue.
LS.3 B The student will investigate and understand patterns of cellular organization and their relationship to life processes in living things.

1. Compare and contrast the basic life functions and processes of an organism and explain the role that each life function serves for an organism.
   a. Recognize that all cells carry out life processes: respiration, removal of wastes (excretion), growth, response (irritability) reproduction, ingestion, digestion, and cellular transport.

2. Recognize the role of cells, tissues, organs, and systems in carrying out life functions.
   a. Comprehend that there is a division of labor for carrying out life processes in multicellular organisms.

3. Model, by creating and interpreting three-dimensional models and/or illustrations, how materials move into and out of cells during the processes of osmosis, diffusion, and active transport.
   a. Compare and contrast osmosis and diffusion.
   b. Predict the net flow of water or other molecules through a semi-permeable membrane.
   c. Understand that during active transport the cell must use energy to move particles from an area of low concentration to an area of high concentration.
Standard LS.4 – BASIC NEEDS AND LIFE PROCESSES

►Reporting Category: Life Systems

LS.4 A The student will investigate and understand the basic needs and life processes of plants.
1. Identify the basic needs of all living things: energy/food, water, minerals, gases, and appropriate environment (space, temperature, and shelter).

2. Identify the basic needs of plants and how they obtain the resources to meet those needs to carry out life processes.
   a. Recognize that plants carry out the processes of both photosynthesis and cellular respiration.
      • Plants need energy from sunlight, water, and gases to carry out the process of photosynthesis whereby they make their own food.
      • Most plants obtain water and nutrients through their roots and carbon dioxide and oxygen from the air in the atmosphere or inside the leaf.
      • Plants produce sugars for cellular respiration as well as other molecules that are used for growth, repair, and development.

LS.4 B The student will investigate and understand the basic needs and life processes of animals.
1. Identify the needs of animals and how they obtain the resources to meet those needs to carry out life processes.
   a. Recognize that animals carry out the process of cellular respiration.
      • Animals must consume other organisms to obtain energy (food) and other nutrients to carry out life processes.
      • Most animals obtain oxygen for cellular respiration from their environment.

2. Distinguish between the needs of plants and animals.

LS.4 C The student will investigate and understand factors that influence life processes of living things.
1. Explain that there is a continuum of conditions that will meet the needs of living things.

2. Create plausible hypotheses and/or predict the effect that changes in available resources might have on particular life processes in plants and in animals (e.g., less light would produce less growth).

3. Analyze and critique the experimental design of basic investigations related to animal and plant needs.
FS.4 D  The student will investigate and understand the characteristics of living things.

1. Identify the characteristics of living things.
   - They are made of cells.
   - They grow, develop, and reproduce.
   - They respond to their environment and maintain homeostasis.
   - They carry out life processes such as ingestion, digestion, and waste removal.
   - At the cellular level, they carry out metabolic processes such as photosynthesis, respiration, diffusion, active transport, and waste removal.

2. Compare and contrast the characteristics of living versus nonliving things.
Standard LS.5 – CLASSIFICATION

► Reporting Category: Life Systems

**LS.5 A** The student will investigate and understand the distinguishing characteristics among kingdoms of organisms.
1. Use a classification system to categorize examples of organisms as representatives of the kingdoms.
   a. Compare and contrast key features and activities between organisms that can be used to classify them into the six kingdoms.
   b. Recognize that the number of kingdoms is subject to change as new information becomes available.
2. Use a dichotomous key to identify organisms.
3. Understand the hierarchical organization of the modern classification system:
   - Seven levels from kingdom to species with increasing specificity at each successive level.
   - Binomial nomenclature.

**LS.5 B** The student will use characteristics to distinguish between major animal and plant phyla.
1. Recognize examples of major animal phyla: cnidarians, mollusks, annelids, arthropods, echinoderms, and chordates.
2. Recognize examples of major plant phyla (divisions): mosses, ferns, conifers, and flowering plants.

**LS.5 C** The student will recognize the characteristics that define a species.
1. Recognize that similar organisms that can interbreed and produce offspring under normal conditions belong to the same species.
Standard LS.6 – PHOTOSYNTHESIS AND RESPIRATION

► Reporting Category: Life Systems

LS.6 A The student will investigate and understand the basic physical and chemical processes of photosynthesis and its importance to plant and animal life.
1. Describe the process of photosynthesis in terms of raw materials and products generated.
   a. Illustrate the transformation of water and carbon dioxide into sugar and water.
   b. Trace the transfer of energy between sunlight and chlorophyll.
2. Identify and describe the organelles and other plant structures involved in the process of photosynthesis.
3. Analyze and critique the experimental design of basic investigations related to photosynthesis.

LS.6 B The student will investigate and understand the basic physical and chemical processes of cellular respiration and its importance to plant and animal life.
1. Use words or chemical equations to compare and contrast the processes of photosynthesis and respiration in terms of raw materials required, products produced, and cellular organelles involved.
2. Recognize that the products of photosynthesis are used by both plants and animals.
   • Cellular respiration is the process whereby all organisms obtain energy.
   • Animals eat plants to obtain stored sugars and other molecules which are the raw materials necessary for movement, growth, repair, development, and reproduction.

LS.6 C The student will investigate and understand that photosynthesis is the foundation of virtually all food webs.
1. Relate the importance of photosynthesis (i.e., the Sun) to the role of producers as the foundation of food webs.
Standard LS.7 – CYCLES AND FOOD WEBS

Reporting Category: Ecosystems

LS.7 A The students will investigate and understand the carbon, nitrogen, and water cycles.
1. Differentiate among key processes in the water cycle and analyze how organisms (from bacteria and fungi to third level consumers) function to recycle matter in an ecosystem.

2. Differentiate among key processes in the carbon cycle and analyze how organisms (from bacteria and fungi to third level consumers) function to recycle matter in an ecosystem.
   a. Recognize that the carbon dioxide – oxygen cycle (photosynthesis and cellular respiration) is part of the carbon cycle.

3. Differentiate among key processes in the nitrogen cycle and analyze how organisms (from bacteria and fungi to third level consumers) function to recycle matter in an ecosystem.

LS.7 B The student will define an ecosystem and identify its components.
1. Define and/or identify the living and nonliving (biotic and abiotic) components of an ecosystem.

2. Observe local ecosystems and identify, measure, and classify the biotic and abiotic components.

3. Define and describe a simple food chain.
LS.7 C  The student will classify and analyze the complex relationships within terrestrial, freshwater, and marine ecosystems.

1. Classify organisms found in local ecosystems as producers or first, second, or third level consumers.
   a. Define, design, construct models, and interpret diagrams of food webs that identify producers, decomposers, and first, second, and third order consumers.
   b. Understand and apply the terms producer, consumer, decomposer, herbivore, carnivore, and omnivore to an organism’s role in a food web or in a community. (Also see LS.9 A).
   c. Relate characteristics of an organism to their role in an ecosystem (e.g., sharp teeth/predator).

2. Observe and identify common organisms in ecosystems; and collect, record, and chart data concerning the interactions and interdependence of organisms in terrestrial, freshwater, and marine ecosystems (from observations, print and electronic resources).
   a. Observe and describe the effects on an ecosystem of changes in the living and nonliving components of that ecosystem.

LS.7 D  The student will use food webs and energy pyramids to analyze the flow of energy in ecosystems.

1. Apply the concepts of food chains, food webs, and energy pyramids to analyze how energy and matter flow through an ecosystem.

2. Define and apply an understanding of the term population. (Also see LS.9 A 1).

3. Determine the relationship between a population’s position in a food web and its size.
   a. Trace and/or describe the flow of energy from the Sun through a food chain, food web, or energy pyramid noting that a high percentage of energy is lost at each step.

4. Analyze and critique the experimental design of basic investigations related to food webs.
Standard LS.8 – INTERACTIONS WITHIN A POPULATION

► Reporting Category: Ecosystems

LS.8 A The student will identify interactions that exist among members of a population.
1. Describe how limiting factors can affect the organisms in a population.
2. Differentiate between the needs of the individual and the needs of a population.
3. Interpret, analyze, and evaluate data (table and/or graph) from systematic studies and experiments concerning the interactions among members of a population.
4. Identify populations in ecosystems; collect, record, chart, and interpret data concerning the interactions of these organisms (from observations, print, and electronic resources).
5. Determine the relationship between a population’s position in a food web and the types of interactions seen among the individuals of the population.
6. Recognize the importance of behavioral adaptations (territorial imperative, courtship, social hierarchy, competition, and cooperation).
7. Analyze and critique the experimental design of basic investigations related to interactions within a population.

LS.8 B The student will investigate and understand the influence of behavior on a population.
1. Recognize that individual behaviors and group behaviors can influence a population.
Standard LS.9 – RELATIONSHIPS AND INTERACTIONS AMONG MEMBERS OF AN ECOSYSTEM

► Reporting Category: Ecosystems

**LS.9 A** The student will understand the interactions among producers, consumers, and decomposers in food webs.
1. Differentiate between organisms, populations, communities, and ecosystems. (Also see LS.11 B).
2. Identify the populations of producers, consumers, and decomposers and describe the roles they play in their communities. (Also see LS.7 C).
3. Interpret, analyze, and evaluate data from systematic studies and experiments concerning the interactions of populations in an ecosystem.
4. Predict the effect of population changes on the food web of a community.

**LS.9 B** The student will investigate and understand the relationship of predators and prey among populations within an ecosystem.
1. Identify predator-prey relationships that occur among populations within a community to understand how balance is maintained in an ecosystem.
   a. Generate interpretations, explanations, and predictions based on graphically represented data of predator-prey populations.

**LS.9 C** The student will investigate and understand competition and cooperation among populations within an ecosystem.
1. Identify examples of competition and cooperation that occur among populations within a community to understand how balance is maintained in an ecosystem.
   a. Generate interpretations, explanations, and predictions based on graphically represented data of competition and cooperation between populations.

**LS.9 D** The student will investigate and understand symbiotic relationships that occur between populations within an ecosystem.
1. Identify symbiotic relationships that occur among populations within a community to understand how balance is maintained in an ecosystem.
   a. Differentiate between the types of symbiosis and recognize examples of each situation: mutualism, commensalism, and parasitism.
LS.9 E  The student will use the physical characteristics of an organism to infer its niche within the ecosystem.
1. Define niche.

2. Infer the niche of an organism from its physical characteristics.
   a. Compare organisms to determine if they might occupy the same niche and how this might affect competition and the amount of available resources in an ecosystem.
Standard LS.10 – BIOMES

► Reporting Category: Ecosystems

LS.10 A  The student will investigate and understand the differences between ecosystems and biomes.
1. Differentiate between ecosystems and biomes.

LS.10 B  The student will investigate and understand the characteristics of land, marine, and freshwater biomes.
1. Compare and contrast the biotic and abiotic characteristics of major land, marine, and freshwater biomes.
2. Compare land, marine, and freshwater biomes in terms of climate (temperature, latitude, elevation, and precipitation) and types of communities.
   a. Recognize and give examples of major terrestrial biomes: desert, forest, grassland and tundra.
   b. Describe how climate influences land environments and determines the types of communities that can exist in a given location.
3. Analyze and critique the experimental design of basic investigations related to how organisms are adapted to biotic and abiotic factors within a specific environment.

LS.10 C  The student will investigate and understand the adaptations that enable organisms to survive within a specific environment.
1. Observe, analyze, and describe examples of specific adaptations that organisms have which enable them to survive in a particular environment (ecosystem or biome).
   • Color change of fur
   • Shape of beak
   • Waxy leaves
   • Clinging vines
2. Match an organism’s structural or behavioral adaptations to its environment.
Standard LS.11 – DYNAMIC CHANGES IN ECOSYSTEMS OVER TIME

► Reporting Category: Ecosystems

LS.11 A The student will investigate and understand that organisms are dynamic and respond to daily, seasonal, and long-term changes in their environment.
   1. Relate the responses of organisms to daily, seasonal, or long-term events in their environment.
      • Phototropism
      • Hibernation
      • Dormancy
      • Migration

LS.11 B The student will investigate and understand the factors that increase or decrease population size within an ecosystem.
   1. Compare and contrast the factors that increase or decrease population size.
      a. Predict the effects of changes/fluctuations in the biotic or abiotic factors such as food availability, disease, temperature, light, rainfall, weather, habitat, predation, invasive species, and other changes in resources for a population.
      b. Interpret and analyze graphs of change in population size over time.

LS.11 C The student will investigate and understand the causes and effects of large-scale changes that occur within an ecosystem.
   1. Classify and describe possible causes of various types of changes that occur over time in ecosystems, communities, populations, and organisms.
      • Succession (primary and secondary)
      • Eutrophication (steps leading to)
      • Climate change (global warming)

   2. Predict the short and long-term effects of catastrophic changes on ecosystems, communities, populations, and organisms: Fire, flood, drought, volcanic eruption, tsunami, tornado, earthquake, etc.

   3. Analyze and critique the experimental design of basic investigations related to change over time in ecosystems, communities, populations, and organisms.
Standard 6.7 – WATERSHED CONNECTIONS

► Reporting Category: Ecosystems

6.7 A The student will investigate and understand the effects of natural and human interactions on the health of a watershed.
1. Understand the causes and effects of changes in abiotic factors that affect water quality such as turbidity, nutrients, sunlight, air quality, and oxygen availability. (Also see LS.7 C).

2. Relate human activities to their effect on the biotic and abiotic components of an ecosystem (e.g., water supply).

6.7 B The student will investigate and understand the location and structure of Virginia’s regional watershed systems.
1. Use a variety of maps (topographic, aerial, street, watershed, and others) to determine the location and size of local and Virginia’s regional watershed systems.

2. Explain the physical/natural features of the Chesapeake Bay Watershed:
   • Geographic location
   • Water characteristics (i.e., fresh water, estuary, salt water)

3. Recognize the role of topography, geology, and groundwater in watershed systems.

6.7 C The student will investigate and understand terminology related to watersheds.
1. Comprehend and apply basic terminology related to watersheds: divide, tributaries, river systems, and river and stream processes (i.e., erosion and deposition.)

6.7 D The student will explain the functioning of wetlands and appraise the value of wetlands.
1. Describe the characteristics of a wetland.

2. Explain the function of wetlands and appraise their value to wildlife and humans.
6.7 E  **The student will explain the characteristics of estuaries and why they are important.**
1. Describe the characteristics of an estuary.

2. Appraise the value of estuaries to wildlife and humans.
   a. Provide examples of natural communities in the Chesapeake Bay (i.e., shad, oysters, submerged aquatic vegetation).
   b. Understand the benefits to humans derived from the Chesapeake Bay (i.e., agriculture, harvesting, transportation, recreation, etc.).

6.7 F  **The student will investigate and understand major conservation, health, and safety issues associated with watersheds and the Chesapeake Bay.**
1. Relate human activities to their possible effects on the Chesapeake Bay populations and organisms: habitat size, quality, and components (bay grasses and over harvesting), and species competition.
   a. Locate and critique a media article or editorial (print or electronic) concerning water use or water quality. Analyze and evaluate the science concepts involved.
   b. Forecast potential water-related issues that may become important in the future.

2. Consider the pros and cons of possible solutions and evaluate trade-offs to environmental issues in the Chesapeake Bay system.
   a. Argue for and against commercially developing a parcel of land containing a large wetland area.
   b. Design and defend a land-use model that minimizes negative impact.

6.7 G  **The student will monitor and analyze water quality using field equipment and hand-held technology.**
1. Measure and record a variety of water quality indicators using field equipment including hand-held technology.

2. Analyze and evaluate indicators of water quality.
   a. Relate the cause and effect(s) of changes in pH, dissolved oxygen, conductivity, and temperature on the health of organisms in an aquatic ecosystem.

3. Explain the factors that influence water quality in a watershed and how those factors can affect organisms in an ecosystem (e.g., nitrogen produced by cars; sewage treatment plant overflow; planting trees to reduce erosion and pollutants; runoff from parking lots; using construction fences to reduce erosion, etc.).
   a. Propose ways to promote high water quality for wildlife and human use within a watershed.
Standard LS.12 – ECOSYSTEM DYNAMICS AND HUMAN ACTIVITY

► Reporting Category: Ecosystems

LS.12 A The student will understand the impact of food production/harvest on the ecosystem.
1. Understand the impact of human food production and harvest on the ecosystem: fishing, harvesting, farming, hunting, etc.

LS.12 B The student will investigate and understand the effects of human actions on habitats.
1. Identify examples of ecosystem dynamics.
2. Relate the positive and negative effects of human actions on habitats.
   a. Predict the change in habitat size, quality, and structure resulting from human activities (e.g., development, logging, pollution, litter, depleting resources, pesticides, introduction of foreign species, etc.).
   b. Observe the effect of human interaction in local ecosystems and collect, record, chart, and interpret data concerning the result of interaction (from observations, print and electronic resources).
   c. Discuss the students’ role in sustaining a balanced environment.
3. Analyze and critique the experimental design of basic investigations related to the relationships between ecosystem dynamics and human activity.

LS.12 C The student will investigate and understand how human actions can alter species competition within an ecosystem.
1. Understand how human actions can alter species competition within an ecosystem. (Also see LS.12 B 2).

LS.12 D The student will investigate and understand population disturbances and factors that threaten and enhance species survival.
1. Compare and contrast population disturbances that threaten and those that enhance species survival.

LS.12 E The student will investigate and understand global environmental issues.
1. Debate the pros and cons of human land use versus ecosystem stability related to water supply, air quality, energy production, and waste management (e.g., oil drilling, rainforest burning, burning fossil fuels, global warming, and energy consumption).
2. Generate and evaluate solutions to environmental problems.
Standard S.13 – HEREDITY AND GENETICS

► Reporting Category: Life Systems

LS.13 A The student will investigate and understand the structure and role of DNA.
   1. Communicate an understanding of the structure and role of DNA.
      a. Explain that DNA contains coded instructions that store and pass on genetic information from one generation to the next.
      b. Recognize the structure of a DNA molecule as a double helix.
      c. Explain the importance of DNA replication for the continuity of life.
   2. Understand that mutation is a change in DNA which can result in a changed trait.

LS.13 B The student will investigate and understand the function of genes and chromosomes.
   1. Describe the basic structure and function of genes and chromosomes.
      • A chromosome is a strand of tightly wound DNA.
      • A gene is a section of a chromosome that carries the code which determines a particular trait.
      • The DNA molecule is made up of sugars, phosphates, and nitrogenous bases whose arrangement forms a chemical code.

LS.13 C The student will predict the possible combinations of inherited factors from single trait crosses.
   1. Define genetics as the scientific study of heredity.
   2. Demonstrate variation within a single genetic trait.
      a. Use a Punnett square to predict the possible combinations of inherited factors resulting from single trait crosses.
      b. Distinguish between dominant and recessive traits.
      c. Distinguish between genotype and phenotype.
   3. Explain how genetic variations in offspring can result from the same two parents, and leads to variation in successive generations.

LS.13 D The student will investigate and understand factors affecting the expression of traits.
   1. Understand that gene expression may be affected by other genes and/or the environment: temperature (e.g., change of coat color of the Himalayan rabbit), nutrition, light, chemicals (e.g., effect of pH on hydrangea flower color), and disease.
LS.13 E  The student will investigate and understand characteristics that can and cannot be inherited.
1. Differentiate between characteristics that can be inherited and those that cannot be inherited.

LS.13 F  The student will investigate and understand genetic engineering and its applications.
1. Identify the basic steps of genetic engineering.
2. Provide examples of applications of genetic engineering in the fields of medicine, agriculture, and biology.
3. Evaluate the possible positive and negative effects of genetic engineering.

LS.13 G  The student will investigate and understand the historical contributions and significance of discoveries related to genetics.
1. Describe the contributions of Mendel, Franklin, Watson and Crick to our basic understanding of genetics.
Standard LS.14 – EVOLUTION THROUGH NATURAL SELECTION

► Reporting Categories: Life Systems (LS.14 A)
   Earth and Space Systems (LS.14 B and LS.14 C)

LS.14 A  The student will describe how changes in the environment can bring about changes in species over time.
   1. Describe how changes in the environment can place stress for survival on populations within an ecosystem.

LS.14 B  The student will describe and explain how fossils are records of organisms and events in the Earth’s history.
   1. Describe and explain how fossils are records of organisms and events in the Earth’s history.
   2. Explain the evidence for evolution from a variety of sources of scientific data: fossil record, radiometric dating, genetic information, the distribution of organisms, and anatomical and developmental similarities across species.

LS.14 C  The student will investigate and understand how environmental influences, as well as genetic variation, can lead to diversity of organisms over time.
   1. Analyze, interpret, and evaluate data from investigations and/or simulations that demonstrate selection for a favorable species’ trait due to a change in environmental conditions.
   • For any given trait, some variation exists within a population.
   • When changes in the environment occur, a particular variation may allow an organism to survive and reproduce more successfully than others in the population (i.e., natural selection).
   • Unfavorable variations may make it difficult for other organisms to survive and, over time, this may lead to extinction.