Paulsboro Schools

Curriculum

Environmental Science

Grade 11/12

<2012 - 2013>

*** For adoption by all regular education programs**
Board Approved: 7/2012
as specified and for adoption or adaptation by
all Special Education Programs in accordance
with Board of Education Policy.

PAULSBORO SCHOOL DISTRICT

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Paulsboro Schools Mission Statement

The mission of the Paulsboro School District is to provide each student educational opportunities to assist in attaining their full potential in a democratic society.

Our instructional programs will take place in a responsive, community based school system that fosters respect among all people.

Our expectation is that all students will achieve the New Jersey Core Curriculum Content Standards (NJCCCS) at every grade level.

New Jersey State Department of Education
21st Century College and Career Readiness Standards

The 12 Career Ready Practices

These practices outline the skills that all individuals need to have to truly be adaptable, reflective, and proactive in life and careers. These are researched practices that are essential to career readiness.

CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP3. Attend to personal health and financial well-being.
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP9. Model integrity, ethical leadership and effective management.
CRP10. Plan education and career paths aligned to personal goals.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.

LAL Standards

LA.9-10.W.9-10.2.A-E
LA.9-10.W.9-10.7
LA.9-10.SL.9-10.1
LA.9-10.SL.9-10.2
LA.9-10.SL.9-10.4
LA.9-10.SL.9-10.5
LA.9-10.L.9-10.4
LA.11-12.W.11-12.2
LA.11-12.W.11-12.7
LA.11-12.SL.1.A
LA.11-12.SL.1.C
LA.11-12.SL.11-12.2
LA.11-12.SL.11-12.4
LA.11-12.SL.11-12.5
LA.11-12.L.11-12.4
LA.11-12.L.11-12.6

MODIFICATIONS

Special Education:
Students Hands on activity, cooperative learning, peer tutoring, extended time, reteach in utilizing various methods.
Utilize remediation resources which include assessment and intervention, in planning and instruction.

English Language Learners:
Provide hands-on activities and explanations. Use reduced text, so that print is not so dense. Assess comprehension through demonstration or other alternative means (gestures, drawings). Give instructions/directions in writing and orally. Use of translation dictionaries to locate words in the native language.
Use English Learners resources such as study guides, assessments and a visual glossary.

At-Risk Students:
Hands on activities cooperative learning, reteach using various methods. Make use of remediation lessons and quizzes when appropriate.

Gifted and Talented Students:
Utilize Pre-AP Resources such as the pacing, assignment and best practices guide.

INTRODUCTION, PHILOSOPHY OF EDUCATION, AND EDUCATIONAL GOALS

Introduction/Philosophy: **"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 advance, 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 understand of the growing body of scientific knowledge that is required of citizens in an ever-changing world.

Educational Goals

Environmental Science is a curriculum that is designed to introduce students to major ecological concepts and the environmental problems that affect the world in which we live. There is an urgent need for environmental education. This program provides one way in which students can become aware of the interactions of people and their environment. The curriculum focuses on concepts that are real-life issues. It promotes awareness and understanding of practical everyday problems that affect their lives. It also relates important environmental issues to the lives of the students and their families

Environmental Science
Scope and Sequence Map

Quarter 1 – 40 days

This unit will cover the concepts of population dynamics, communities and ecosystems, and global issues. Also included in this unit will be discussions on environmental concerns and possible solutions to these problems

I. Ecology
   a. Interactions in the biosphere
   b. Community Ecology
   c. Population Ecology
   d. Ecosystems
   e. Soils

Quarter 2 – 40 days

This unit will cover the concepts of early evolution of life, evidence for evolution, and the mechanisms of evolution

II. Evolutionary Biology
   a. Darwin's theory of Natural Selection
   b. Population Genetics
   c. Speciation

Quarter 3 – 40 days

This unit will cover the biogeochemical cycles and how human activities influence the cycling of matter

IV. Biogeochemical cycles
   a. Hydrological cycle
   b. Nutrient cycles (carbon, nitrogen)
   c. Human influences on biogeochemical cycles

Quarter 4 – 40 days

This unit will cover the various types of pollution and their effect on the environment

V. Pollution
   a. Air pollution and noise pollution
   b. Water pollution and solid waste
   c. Impacts of pollution on the environment and human health

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.

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.

Essential Questions	Enduring Understandings
How is matter transferred and energy transferred/ transformed in living systems?	All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
Content Statements	**Cumulative Progress Indicators**
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.	Cite evidence that the transfer and transformation of matter and energy links organisms to one another and to their physical setting. **(5.3.12.B.1)**

Instructional Focus:

- Tracing the cycling of atoms and molecules on Earth among the living and nonliving components of the biosphere
- Explaining how molecules are used to assemble larger molecules with biological activity (including proteins, DNA, sugars and fats)
  - *Assessments will not include the representations of specific detailed steps of synthesis and decomposition (intermediate steps and molecules, details of dehydration synthesis)*
- Following the transfer of matter (molecules) from one organism to another repeatedly and between organisms and their physical environment
- Identifying how the total amount of matter in a system remains constant, even though its form and location change

Desired Results	Investigations, Labs, and Sense Making Experiences
Construct a representation that links the movement of matter (i.e., carbon atom, water molecule) and the transfer of energy through the processes of photosynthesis and cellular respiration. Predict and justify, based on knowledge of energy transfer and matter cycling, what might happen to the mass of a biosystem if the source of energy were limited. Explain what are ecosystems and how do ecosystems work Define the competitive exclusion principle and explain how it relate to the introduction of non-native species Identify the law of limiting factors and explain how does it relate to the growth, survival and reproduction of a species Describe biotic and abiotic factors and analyse how they impact ecosystems Explain what role ecosystem interactions play in competitive and non-competitive relationships? Give examples of major events in human history have defined human interactions with ecosystems	• Detailed chapter outlines for each unit • Answer essential questions • Ecosystem (biome) project • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Leaf identification lab • Insect study and identification lab Summative Assesssment/Project: Students are to imagine that they are a wildlife biologist that has been hired to publish and write a field guide for the local nature area. Students will make daily observations and conduct field research in a local nature area. The field guide must include the following components: Identification and classification of 7 trees, Identification and classification of 5 insects, identification of animal tracks, determination of soil texture, soil pH, soil profile and soil nutrient composition, soil temperature and air temperature in the form of a line graph, graph of soil pH, general survey or model, discussion of data and questions for further research **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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.

Essential Questions	Enduring Understandings
How is matter transferred and energy transferred/ transformed in living systems?	All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.
Content Statements	**Cumulative Progress Indicators**
Each recombination of matter and energy results in storage and dissipation of energy into the environment as heat.	Use mathematical formulas to justify the concept of an efficient diet. **(5.3.12.B.2)**

Instructional Focus:

- Explaining how food webs are limited and how pyramidal relationships exist
- Recognizing that all matter tends toward more disorganized states, and that living systems require a continuous input of energy to maintain their chemical and physical organizations
- Recognizing that the chemical bonds of food molecules contain energy, which is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed
    - *Assessments will not include the representations of specific detailed steps of synthesis and decomposition (intermediate steps and molecules, details of dehydration synthesis)*
- Calculating the trends in production, use and transfer of energy from one trophic level to another using data

Desired Results	Investigations, Labs, and Sense Making Experiences
Construct a model of a food chain that includes a quantification of the distribution and buildup of a potentially damaging chemical that is introduced into an ecosystem. Predict, using the model, consequences at each trophic level as the relative concentration of the chemical increases. Justification includes changes in the number of organisms at each trophic level, matter cycling, and energy transfer from one level to another. In Kcal analyze and quantify the movement of a given quantity of energy through an actual ecosystem Construct a representation of the transfer of energy through an ecosystem, starting with the Sun and ending with increased motion of molecules in the environment. Representation should reflect the idea that energy is conserved. Explain, based on the transformation of chemical energy to thermal energy at various trophic levels and on the nature of reactions, the need for constant input of energy into an ecosystem. What is a biomass pyramid and how does it relate to trophic structures	• Detailed chapter outlines for each unit • Answer essential questions • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Energy pyramid analysis • Food chain project • Non native species project • Owl pellet dissection Project: Students are to pretend that they are sixth grade life science teachers. They are to prepare a lesson to teach a sixth grade class about biogeochemical cycles. Each person will be assigned a specific biogeochemical cycle (carbon, nitrogen, phosphorus). The lesson must include 10 minutes of direct instruction and include the following components: Written notes explaining the assigned biogeochemical cycle describing how the nutrient flows through biotic and abiotic spheres, diagram/picture of the cycle, closure containing key points to remember, activity for independent practice of taught material and quiz to assess the effectiveness of the lesson **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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.

C. Interdependence: All animals and most plants depend on both other organisms and their environment to meet their basic needs.

Essential Questions	Enduring Understandings
How are organisms dependant on each other?	The survival of organisms is affected by interactions with each other and their environment, and can be altered by human manipulation.
Content Statements	**Cumulative Progress Indicators**
Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms.	Analyze the interrelationships and interdependencies among different organisms, and explain how these relationships contribute to the stability of the ecosystem. **(5.3.12.C.1)**

Instructional Focus:

- Analyzing the interactions between organisms that result from the ability to produce populations of infinite size in an environment where resources are finite
- Providing evidence of how organisms both cooperate and compete in ecosystems
- Using evidence to explain why interrelationships and interdependencies of organisms may generate stable ecosystems

Desired Results	Investigations, Labs, and Sense Making Experiences
Describe the abiotic characteristics of an ecosystem: its boundaries, its components, its inputs and outputs, and its interactions, as well as the boundaries and other characteristics of overlapping ecosystems. Analyze data (e.g., mean, mode, spread of data, sampling error) that show the number of different species and the number of organisms within a species in two or more ecosystems over time (one of the ecosystems has more fluctuations than the other). Make a claim about the relative stability of each ecosystem. Devise a measure of relative stability, taking into account whether the stability is simply a lack of fluctuation of organism numbers, or if the stability should be measured based on a regular recurrence of a cyclical pattern of variation in an ecosystem. Analyze data that depict changes in the abiotic components of an ecosystem and changes in the biotic components of an ecosystem over time (e.g., percent change, average change, correlation and proportionality). Evaluate claims of possible relationships between the changes in the abiotic components and the biotic components of the environment. Explain how do populations change over time and how do the interactions between organisms affect population dynamics Define limiting factors of population growth, succession and explain how it affect ecosystems Describe the role disturbance play in ecosystems	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Ecosystem/Biome project • Ecosystem webquest • Succession Lab • Population dynamics Lab Summative Assessment/Project: Students are to imagine that they are conservationists working to preserve endangered species. The task is to prepare a 15 minute persuasive presentation designed to convince a committee of the World Wildlife Federation to approve their proposal for funding to work towards the preservation of a species. The following components must be included in the presentation: What is the ecological niche of the species, what has led to the endangerment of the species, why should this species be saved from extinction (moral, economic, social/cultural, scientific reasons), what is currently being done to prevent this species from going extinct, has this been successful or not and what should be done to prevent this species from extinction? **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

C. Interdependence: All animals and most plants depend on both other organisms and their environment to meet their basic needs.

Essential Questions	Enduring Understandings
How are organisms dependant on each other?	The survival of organisms is affected by interactions with each other and their environment, and can be altered by human manipulation.
Content Statements	**Cumulative Progress Indicators**
Stability in an ecosystem can be disrupted by natural or human interactions.	Model how natural and human-made changes in the environment will affect individual organisms and the dynamics of populations. **(5.3.12.C.2)**

Instructional Focus:

- Identifying situations where humans intentionally and unintentionally modify ecosystems as a result of population growth, technology, and consumption
- Providing evidence of how human destruction of habitats threatens current local and global ecosystem stability
- Predicting how direct harvesting, pollution, atmospheric changes, and other factors will affect population dynamics in a given ecosystem based on data and accepted mathematical models
- Predicting how natural disasters such as hurricanes, floods, volcanoes will affect population dynamics in a given ecosystem based on data and accepted mathematical models

Desired Results	Investigations, Labs, and Sense Making Experiences
Describe the abiotic characteristics of an ecosystem: its boundaries, its components, its inputs and outputs, and its interactions, as well as the boundaries and other characteristics of overlapping ecosystems. Analyze data that depict changes in the abiotic components of an ecosystem and changes in the biotic components of an ecosystem over time (e.g., percent change, average change, correlation and proportionality). Evaluate claims of possible relationships between the changes in the abiotic components and the biotic components of the environment. Predict what will happen to the number of organisms of a given species in an ecosystem following a temporary biotic or abiotic change in that ecosystem (e.g., a very cold winter or a disease that kills large numbers of one of the species in the ecosystem) and what will happen after conditions return to what they were before the disruption. Justification for the prediction is based on knowledge of how ecosystems typically respond to temporary changes in environmental conditions, how this particular ecosystem has responded to such changes in the past, and the scale of these particular changes. Describe succession and how it affect ecosystems and explain what role disturbance play in ecosystems Analyze why fire is a necessary component of some ecosystems Show how the population dynamics within an ecosystem affect human population	• Detailed chapter outlines for each unit • Answer essential questions • Corresponding worksheets • Literature review research papers based on current scientific articles Summative Assessment/Project Students are to pretend that they are members of the community surrounding Yellowstone National Park. Theirr task is to prepare to attend a town hall meeting (debate) on fire management practices in Yellowstone Park. Students will research the following: the history of fire management practices in the park and the advantages and disadvantages of each. They will prepare a 10 minutes persuasive power point presentation representing an assigned interest group. (Wildlife biologist, small business owner, fire fighter, home owner and development investor). The task is to persuade the town council to vote in factor of your proposed fire management strategy. Students must include the following components in their presentation: Brief history of fire management practices in the park, affects of fire of Yellowstone ecosystems, advantages of past and current fire management practices, disadvantages of past and current fire management practices and social, Economic and Political Implications of fire management practices on assigned interest groups. After all presentations, the town council (class) will vote on which strategy should be implemented. **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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.

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.

Essential Questions	Enduring Understandings
How does natural selection encourage inter and intra-specific diversity over time?	The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring.
Content Statements	**Cumulative Progress Indicators**
New traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.	Account for the appearance of a novel trait that arose in a given population. **(5.3.12.E.1)**

Instructional Focus:

- Recognizing how heritable characteristics can strongly influence how likely an individual is to survive and reproduce
- Describing how evolution involves changes in the genetic make-up of whole populations over time, not changes in the genes of an individual organism
- Analyzing natural selection simulations and use the data generated to describe how environmentally favored traits are perpetuated over generations resulting in species survival, while less favorable traits decrease in frequency or may lead to extinction

Desired Results	Investigations, Labs, and Sense Making Experiences
Provide evidence — reported in print and electronic resources, and regarding similarities and differences between organisms from the fossil record and preserved DNA — that supports the idea of descent with modification. Explain how similarities and differences among organisms support the idea of descent with modification. Give examples of how, following a change in environmental conditions, variation in traits within a specific population of organisms might affect the survival and reproductive ability of some of the organisms in that population, but not other organisms in the same population. Give examples of other environmental changes that may not affect the survival and reproduction of any of these organisms. Describe the type of data needed to determine whether the survival or reproductive success of individual organisms was due to the genetic variation within the population. Explain similarities and differences between populations (e.g., dogs, horses, crops) undergoing artificial selection and populations undergoing natural selection. Describe the roles that humans play in artificial selection and how these roles are similar to the natural processes that take place in natural selection. Give examples, using information gathered from print and electronic resources, of observations made by Charles Darwin of variation within species and of changes in environmental conditions that he used in the development of his theory of natural selection. For each example, explain how the observations support the theory of natural selection Explain what a species is and how new species evolve Describe how evolution is relate to ecosystems Describe how traits are inherited and how gene pools can be manipulated over time	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Pro vs con evolution research paper **Optional Lab:** **AP Lab 8: Population Genetics and Evolution*** *Lab Objective:* *discuss natural selection and other causes of microevolution and deviations from the conditions required to maintain Hardy-Weinberg equilibrium*

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.

Essential Questions	Enduring Understandings
How does natural selection encourage inter and intra-specific diversity over time?	The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring.
Content Statements	**Cumulative Progress Indicators**
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.	Provide a scientific explanation for the history of life on Earth using scientific evidence (e.g., fossil record, DNA, protein structures, etc.). **(5.3.12.E.3)**

Instructional Focus:

- Recognizing that a change in a species over time does not follow a set pattern or timeline
- Explaining how the millions of different species on Earth today are related by common ancestry using evidence
- Using natural selection and its evolutionary consequences to provide a scientific explanation for the fossil record of ancient life forms, and the molecular similarities observed among the diverse species of living organisms
    - *Assessments will not include the classification of organisms in taxa*

Desired Results	Investigations, Labs, and Sense Making Experiences
Compare the effects of a significant environmental change on a population with great genetic diversity and the effects of such a change on a population with little genetic diversity. In each instance, indicate the environmental change, the organisms within the species that were affected, and the organisms that were not affected. Explain why genetic variation among organisms within the species affected the survival of the species. Construct a model or run a simulation that represents natural selection in terms of how changes in environmental conditions can result in selective pressure on a population of organisms. Calculate measures of central tendencies (i.e., mean, median, mode), represent spread of data (e.g., range), and determine error (e.g., number of **outliers**) of each variable in order to analyze the data and make a claim about the patterns observed. Explain how each part of the model or simulation is similar to, or different from, the process of natural selection. Predict and justify, based on ideas about natural selection, what might happen to a population of organisms after many generations if the population becomes geographically isolated from another population of the same species, and if the two groups experience different **biotic** and/or environmental conditions. Explain what a species is and how new species evolve Describe how evolution is relate to ecosystems Describe how traits are inherited and how gene pools can be manipulated over time	• Detailed chapter outlines for each unit • Answer essential questions • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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.

Essential Questions	Enduring Understandings
How does natural selection encourage inter and intra-specific diversity over time?	The diversity and changing of life forms over many generations is the result of natural selection, in which organisms with advantageous traits survive, reproduce, and pass those traits to offspring.
Content Statements	**Cumulative Progress Indicators**
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 • Natural selection, due to environmental pressure, of those organisms better able to survive and leave offspring	Account for the evolution of a species by citing specific evidence of biological mechanisms. **(5.3.12.E.4)**

Instructional Focus:
- Discussing how environmental pressure, genetic drift, mutation and competition for resources influence the evolutionary process
- Predicting possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, pollution)

Desired Results	Investigations, Labs, and Sense Making Experiences
Give examples of how, following a change in environmental conditions, variation in traits within a specific population of organisms might affect the survival and reproductive ability of some of the organisms in that population, but not other organisms in the same population. Give examples of other environmental changes that may not affect the survival and reproduction of any of these organisms. Describe the type of data needed to determine whether the survival or reproductive success of individual organisms was due to the genetic variation within the population. Explain similarities and differences between populations (e.g., dogs, horses, crops) undergoing artificial selection and populations undergoing natural selection. Describe the roles that humans play in artificial selection and how these roles are similar to the natural processes that take place in natural selection. Predict and justify, based on ideas about natural selection, what might happen to a population of organisms after many generations if the population becomes geographically isolated from another population of the same species, and if the two groups experience different **biotic** and/or environmental conditions. Identify similarities and differences between natural selection and artificial selection Describe how traits are inherited and how gene pools can be manipulated over time Explain how the theory of plate tectonics relates to ecosystems	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

5.4 Earth Systems Science: All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.

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.

Essential Questions	Enduring Understandings
How do changes in one part of an Earth system affect other parts of the system?	Ecosystems are the result of the interactions among Earth's biosphere, geosphere, atmosphere, and hydrosphere.
Content Statements	**Cumulative Progress Indicators**
Soils are at the interface of the Earth systems, linking together the biosphere, geosphere, atmosphere, and hydrosphere.	Model the interrelationships among the spheres in the Earth systems by creating a flow chart. **(5.4.12.C.1)**

Instructional Focus

- The transfer of matter and energy between the biosphere, geosphere, atmosphere, and hydrosphere often takes place in soils
- The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants.
- The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.
- Earth's atmosphere exchanges energy and matter within the Earth System through processes such as photosynthesis, the water cycle, biogeochemical cycles, the rock cycle and ocean currents.
- The four major systems of Earth are the geosphere, hydrosphere, atmosphere, and biosphere. The geosphere includes a metallic core, solid and molten rock, soil, and sediments. The atmosphere is the envelope of gas surrounding Earth. The hydrosphere includes the ice, water vapor, and liquid water in the atmosphere, the ocean, lakes, streams, soils, and groundwater. The biosphere includes Earth's life, which can be found in many parts of the geosphere, hydrosphere, and atmosphere. Humans are part of the biosphere, and human activities have important impacts on all four spheres.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain that weathering is the physical and/or chemical break up of rocks at or near the Earth's surface Describe soils as the result of weathering and biological activity over extended time Analyze soil composition and properties as well as soil organism composition Describe why is soil significant for ecosystem function Identify why desertification occurs and how can it be avoided Determine the current advantages and disadvantages of technologies currently utilized for soil conservation	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Soil texture, pH, profile and nutrients testing lab • Soil texture, composition and nutrient testing lab • Soil organism lab Summative Assessment/Project: Students are soil scientists that have been hired by a group of local farmers. The challenge is to determine why the current crop of tomatoes and corn is not as productive as it has been in the past. The task is to determine if the limiting factor is the result of nutrient deficiency or organisms present in the soil and solve the problem affecting the crops and prepare a formal lab report including the following components: soil nutrient testing data and conclusions, soil organisms testing data and conclusion, soil texture and composition data and conclusions, water qualitative analysis data and conclusions, discussion of all data collected and conclusions reached in a formal lab report format with recommendations for the solution of the problem **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

5.4 Earth Systems Science: All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.

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.

Essential Questions	Enduring Understandings
In what ways do changes in earth's atmosphere affect the earth?	Composition of the soils and atmosphere provide the interfaces for changes in the composition of the Earth's systems
Content Statements	**Cumulative Progress Indicators**
The chemical and physical properties of the vertical structure of the atmosphere support life on Earth.	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. **(5.4.12.C.2)**

Instructional Focus

- Life is adapted to conditions on the earth, including the force of gravity that enables the planet to retain an adequate atmosphere, and an intensity of electromagnetic waves from the sun that allows water to be present in the liquid state.
- Greenhouse gases in the atmosphere, such as carbon dioxide and water vapor, are transparent too much of the incoming sunlight but not to the infrared light from the warmed surface of the earth. When greenhouse gases increase, more thermal energy is trapped in the atmosphere, and the temperature of the earth increases the light energy radiated into space until it again equals the light energy absorbed from the sun.
- The atmosphere has mass, is bound to Earth by gravity, and exerts pressure which is greater near Earth's surface and decreases with altitude.
- The atmosphere, which is very thin relative to Earth's radius, varies vertically in layers which differ in composition, density, and temperature. The lowest 8-16 km of the atmosphere - the troposphere - contains most of Earth's weather systems.

Desired Results	Investigations, Labs, and Sense Making Experiences
Identify the causes and effects of global warming and discuss some strategies to reduce global warming trends and what their significance Analyze the current laws that are in place to protect against global warming; globally, nationally and locally Identify ways that individuals can help prevent global warming Identify and describe the layers of the atmosphere Describe the stratospheric ozone and how it forms ozone	• Corresponding worksheets • Soil texture, pH, profile and nutrients testing lab • Soil texture, composition and nutrient testing lab • Simulating Greenhouse Effects Lab • Video: An inconvenient Truth Summative Assessment/Project: Students are to imagine that they are eighth grade earth science teachers. The challenge is to teach a lesson to an eighth grade science class on global warming. Each lesson should include the following on global warming: Causes, effects, significance, future implications and strategies that the average eighth grader can employ to help in the fight against global warming. **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

5.4 Earth Systems Science: All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.	
F. Climate and Weather: Earth's weather and climate systems are the result of complex interactions between land, ocean, ice, and atmosphere.	
Essential Questions	**Enduring Understandings**
What are the factors that control Earth's climate and weather? Is it possible for humans to influence a system as large as climate?	Climate is influenced by interactions of multiple physical, chemical and biological factors, including human actions.
Content Statements	**Cumulative Progress Indicators**
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.	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. **(5.4.12.F.2)**

Instructional Focus

- Climatic conditions result from latitude, altitude, and from the position of mountain ranges, oceans, and lakes. Dynamic processes such as cloud formation, ocean currents, and atmospheric circulation patterns influence climates as well.
- The Earth's climates have changed in the past, are currently changing, and are expected to change in the future, primarily due to changes in the amount of light reaching places on the earth and the composition of the atmosphere. The burning of fossil fuels in the last century has increased the amount of greenhouse gases in the atmosphere, which has contributed to Earth's warming.
- Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth's land, oceans, and atmosphere. Some of these changes have decreased the capacity of the environment to support some life forms.

Desired Results	**Investigations, Labs, and Sense Making Experiences**

Relate how latitude and the different rates of heating of water and land affect climate. Analyze and explain the climate differences found in a city vs. a rural region. Explain the difference between short-term (weather) and long-term climatic changes, and to give examples of each type. Classify climatic changes as changes according to whether they are largely astronomical phenomena or Earth-based processes.	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Climate Zones project • Global Warming booklet Summative Assessment/Project: Beyond El Niῆo's effects on weather and climate, the sudden presence of warm water off the western coast of South America also has profound effects on marine ecosystems. Have students research and report on the impact of El Niῆo on the food chains of this coastal area. Students should share their results with the class **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

5.4 Earth Systems Science: All students will understand that Earth operates as a set of complex, dynamic, and interconnected systems, and is a part of the all-encompassing system of the universe.

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.

Essential Questions	Enduring Understandings
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation.
Content Statements	**Cumulative Progress Indicators**
Natural and human-made chemicals circulate with water in the hydrologic cycle.	Analyze and explain the sources and impact of a specific industry on a large body of water (e.g., Delaware or Chesapeake Bay). **(5.4.12.G.1)**

Instructional Focus

- The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.
- Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications (changes to beaches, shores and rivers).
- Water resources are essential for agriculture, manufacturing, energy production, and life. Earth scientists and engineers find and manage our fresh water resources, which are limited in supply. In many places, humans withdraw both surface water and groundwater faster than they are replenished. Once fresh water is contaminated, its quality is difficult to restore.
- Humans affect the quality, availability, and distribution of Earth's water through the modification of streams, lakes, and groundwater. Engineered structures such as canals, dams, and levees significantly alter water and sediment distribution. Pollution from sewage runoff, agricultural practices, and industrial processes

reduce water quality. Overuse of water for electric power generation and agriculture reduces water availability for drinking.

Desired Results	Investigations, Labs, and Sense Making Experiences
Identify the properties of water that make it unique? Demonstrate and diagram how the hydrologic cycle works? Describe the affect do human beings have on the water cycle including the cause and effect of water pollution and identifying the significance of water pollution? Explain why water conservation is important and list some ways to conserve water Compare and contrast the advantages and disadvantages of technologies currently utilized for water conservation Report on why wastewater treatment and watershed management is important to the average American	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Hydrologic cycle diagram • Report on the various technologies currently utilized for water conservation • Report on watershed management • Water, water everywhere but not enough to drink activity **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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Essential Questions	Enduring Understandings
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation.
Content Statements	**Cumulative Progress Indicators**
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.	Explain the unintended consequences of harvesting natural resources from an ecosystem. **(5.4.12.G.2)**

Instructional Focus

- Human beings are part of the earth's ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems.
- Although Earth has a great capacity to absorb and recycle materials naturally, ecosystems have only a finite capacity to withstand change without experiencing major ecological alterations that may also have adverse effects on human activities.
- The concept of Ecosystem Services is becoming popular as a way to encourage discussion about the dependence of humans on nature and what that means socially and economically. Ecosystem services are transformations of natural assets (soil, water, air, and living organisms) into products that are important to humans. Examples include: provision of clean air and water; maintenance of soil fertility; maintenance of liveable climates; pollination of crops and other vegetation; control of potential pests; provision of genetic resources; production of food and fiber; and provision of cultural, spiritual and intellectual experiences.
- The value of ecosystem services to humans comes from their role in supporting our lives, their cheapness, and our limited ability to replace them with human-engineered alternatives.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain how do human activities impact the Earth's ecosystem Define ecosystem management and describe how it works Analyze why is there hunger, famine and malnutrition in human populations Describe the advantages and disadvantages of the technologies currently utilized to address the problems of food production, distribution and world hunger Explain the role population dynamics plays in the hunger, malnutrition and famine of human populations and what are the major patterns of food production and distribution around the world	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Genetically modified food survey and activity Summative Assessment/Project: Students are considering investing in Cabot Oil & Gas Corporation who has been a leader in the extraction of natural gas from shale in the US. The ability to extract gas from shale — which can involve a process known as fracking — has been welcomed as an economic windfall by some communities and has been resisted in others because of residents' concerns about the potential harm to their drinking water. As part of their due diligence research, students found an article titled When a Rig Moves In Next Door. After students read the article, they will craft a letter to the broker informing him of their decision to purchase the stock or not. In the letter, students will include the decision, the evidence that was found in the article that supports their decision, and a rationale for the decision. **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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Essential Questions	Enduring Understandings
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation
Content Statements	**Cumulative Progress Indicators**
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.	Demonstrate, using models, how internal and external sources of energy drive the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles. **(5.4.12.G.3)**

Instructional Focus

- All Earth processes are the result of energy flowing and mass cycling within and between Earth's systems. This energy is derived from the sun and Earth's interior. The flowing energy and cycling matter cause chemical and physical changes in Earth's materials and living organisms. For example, large amounts of carbon continually cycle among systems of rock, water, air, organisms, and fossil fuels such as coal and oil.
- Earth exchanges mass and energy with the rest of the Solar System. Earth gains and loses energy through incoming solar radiation, heat loss to space, and gravitational forces from the sun, moon, and planets. Earth gains mass from the impacts of meteoroids and comets and loses mass by the escape of gases into space.
- The chemistry of ocean water is changed by absorption of carbon dioxide from the atmosphere. Increasing carbon dioxide levels in the atmosphere is causing

ocean water to become more acidic, threatening the survival of shell-building marine species and the entire food web of which they are a part.

Desired Results	Investigations, Labs, and Sense Making Experiences
Describe soils as the result of weathering and biological activity over extended time Explain that erosion is the transport of weathered materials from one location to another by any means Describe the major agents of erosion which includes: wind, glaciers, flowing fresh waters, ocean currents and waves and gravity induced directed flows	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets Summative Assessment/Project: Evaluate evidence contained in data sets and current models of Water Cycles, construct an argument regarding the claim that humans have serious problems with respect to how the water cycle functions. The Water Cycle and Global Warming, http://www.bioedonline.org/lessons/water-cycle.cfm **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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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.

Essential Questions	Enduring Understandings
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation.
Content Statements	**Cumulative Progress Indicators**
Natural and human activities impact the cycling of matter and the flow of energy through ecosystems.	Compare over time the impact of human activity on the cycling of matter and energy through ecosystems. **(5.4.12.G.4)**

Instructional Focus

- The transport and transformation of substances through the Earth system are known collectively as biogeochemical cycles**.** These include the hydrologic (water), nitrogen, carbon, and oxygen cycles. Human activities can, deliberating or inadvertently, alter the equilibrium of these cycles.

Desired Results	Investigations, Labs, and Sense Making Experiences

Describe and model how elements essential to life cycle through ecosystems Discuss human impact on the cycling of matter throughout the environment Explain how population density impacts different cycles	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Diagram the carbon, phosphorus and nitrogen cycles **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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Essential Questions	**Enduring Understandings**
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation.
Content Statements	**Cumulative Progress Indicators**
Human activities have changed Earth's land, oceans, and atmosphere, as well as its populations of plant and animal species.	Assess (using maps, local planning documents, and historical records) how the natural environment has changed since humans have inhabited the region. **(5.4.12.G.5)**

Instructional Focus

- The survival of human societies is dependent on Earth's resources. Overall, there are positive correlations between population, natural resource consumption and environmental degradation, although environmental policies and technology influence these relationships. This can be applied to the regional, national and global scales.
- While urbanization may involve or provide a number of economic, social and environmental benefits, the global population demographic trend of increased urbanization that has been seen as more countries prepare to further industrialize may be associated with negative environmental and human health

consequences.

- The size and rate of growth of the human population in any location are affected by economic, political, religious, technological and environmental factors. Some of these factors, in turn, are influenced by the size and rate of growth of the population.
- Decisions to slow the depletion of energy resources can be made at many levels, from personal to national, and they always involve trade-offs involving economic costs and social values.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain how population density impacts different ecosystems Understand the strategies for obtaining measurements and systematically collecting data. Recognize that predictions or explanations can be revised on the basis of seeing new data and evidence.	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets • Record and analyze data from short and long term observational data. • Create/analyze and extrapolate graphical data • Id various map/charts Summative Assessment/Project: Alternative-fuel vehicles: Ask students to research alternative –fuel vehicles currently available to the public. Have them compare the efficiency and emission statistics of those cars with those of a comparably sized fossil fuel-burning vehicle. Students will evaluate both vehicles and summarize their findings in a brief report or display **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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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.

Essential Questions	Enduring Understandings
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation.
Content Statements	**Cumulative Progress Indicators**
Scientific, economic, and other data can assist in assessing environmental risks and benefits associated with societal activity.	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 **(5.4.12.G.6)**

Instructional Focus

- Decisions that affect the environment are not based on scientific analysis alone, but must also incorporate social and economic considerations.
- The benefits, costs and risks of decisions may not be evenly shared among all parties. In many cases, economically disadvantaged and/or minority groups have disproportionately suffered from these decisions, leading to concerns of *environmental*
- *L*ocal, national and international laws, treaties and regulations have helped to manage environmental impacts. There are many examples of damaged ecosystems that have been successfully restored.
- People sometimes consider a local natural area or broader ecosystem to be "priceless" and hence refuse to put a dollar value on it. However, amid the conflicting interests of modern economic systems, the value of such ecosystems may then in practice be considered to be zero in economic analyses and public policy decisions.
- Answer approach used by a growing number of environmental scientists, ecologists and economists has been to try to assign dollar values, not to the ecosystem itself but to the services it provides. This can be determined by estimating the cost of providing the same service through human activity. In many cases, the value of these services is found to be very high, and thus maintenance of the functioning ecosystem becomes a high priority.

Desired Results	Investigations, Labs, and Sense Making Experiences
Explain the relationship between economics & the environment. Explain the purpose of environmental policy. Describe the history of U.S. environmental policy. Describe the direction of current U.S. environmental policy. Identify major international institutions involved in environmental policy. Discuss different approaches to environmental policy. . Explain the importance of managing specific renewable resources. Describe three resource management approaches List some of the ecological & economical values of forest resources.	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets Summative Assessment/Project: Suppose you go to a school that releases helium balloons during graduation - one balloon for each graduating senior. Sounds harmless enough, but you suspect otherwise. **Task:** Write a fact sheet about the environmental costs of releasing helium-filled balloons. Your goal is to persuade the student council to reconsider the value of this tradition. Include visuals (photos, diagrams, or graphic organizers) to support your argument. **Core Instructional Materials** Holt Science Spectrum Glencoe Biology

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Essential Questions	Enduring Understandings
To what extent can human behaviors impact our planet's life support system (environment)?	Human activities have physical, chemical, and biological consequences for ecosystems; the magnitude of the impact depends in part on the sensitivity of the system to perturbation.
Content Statements	**Cumulative Progress Indicators**
Earth is a system in which chemical elements exist in fixed amounts and move through	Relate information to detailed models of the hydrologic, carbon, nitrogen, phosphorus,

the solid Earth, oceans, atmosphere, and living things as part of geochemical cycles.	sulfur, and oxygen cycles, identifying major sources, sinks, fluxes, and residence times. **(5.4.12.G.7)**

Instructional Focus

- Much of the complex behavior of the Earth system can be thought of as cycles involving physical, chemical and biological processes that transfer components among various storage locations over time.
- The inputs and outputs connecting such reservoirs, the changes in the physical state or chemical characteristics of the components, and the time scale of these processes can all be recognized and quantified.
- Biogeochemical cycles, such as the water cycle and carbon cycle, are driven and sustained by solar and/or geothermal energy, which is transferred, utilized and lost as an integral aspect of the cycles.

Desired Results	Investigations, Labs, and Sense Making Experiences
Describe two major ways that Earth's systems interact. Research the structure and composition of Earth's atmosphere, biosphere, geosphere, and hydrosphere. Report their findings to the rest of the class, sharing and communicating the evidence and data they uncovered as a group.	• Detailed chapter outlines for each unit • Literature review research papers based on current scientific articles • Discussions and discussion analyses • Corresponding worksheets Summative Assessment/Project: Working in small groups, students research one of the major Earth systems (atmosphere, biosphere, geosphere, and hydrosphere). Each group determines the chemical composition and physical characteristics of one system. They highlight those substances that are abundant in each system. One student in each group becomes the "expert" on a certain substance found in the system (e.g. carbon, nitrogen, oxygen, water, etc.). They focus their work on how the substance moves through the system, including how it enters and exits the system. When all the groups have completed their research, they present their findings to the rest of the class. They construct a model or representation (physical or digital) of their Earth system and teach the class about the system. All students take note of all of the Earth systems discussed.

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.

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.

Essential Question	Enduring Understanding
How do we build and refine models that describe and explain the natural and designed world?	Measurement and observation tools are used to categorize, represent and interpret the natural world.
Content Statement	**Cumulative Progress Indicator**

Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.	Refine interrelationships among concepts and patterns of evidence found in different central scientific explanations. **(5.1.12.A.1)**

Instructional Focus:

- Learning facts, concepts, principles, theories and models; then
- Developing an understanding of the relationships among facts, concepts, principles, theories and models; then
- Using these relationships to understand and interpret phenomena in the natural world

Content Statement	Cumulative Progress Indicator
Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations.	Develop and use mathematical, physical, and computational tools to build evidence-based models and to pose theories. **(5.1.12.A.2)**

Instructional Focus:

- Using tools, evidence and data to observe, measure, and explain phenomena in the natural world
- Developing evidence-based models based on the relationships among fundamental concepts and principals
- Constructing and refining explanations, arguments or models of the natural world through the use of quantitative and qualitative evidence and data

Content Statement	Cumulative Progress Indicator
Revisions of predictions and explanations are based on systematic observations, accurate measurements, and structured data/evidence.	Use scientific principles and theories to build and refine standards for data collection, posing controls, and presenting evidence. **(5.1.12.A.3)**

Instructional Focus:

- Understanding that data differs in quality and strength of explanatory power based on experimental design
- Evaluating strength of scientific arguments based on the quality of the data and evidence presented
- Critiquing scientific arguments by considering the selected experimental design and method of data analysis

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.

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.

Essential Question	Enduring Understanding
What constitutes useful scientific evidence?	Evidence is used for building, refining, and/or critiquing scientific explanations.

Content Statement	Cumulative Progress Indicator
Logically designed investigations are needed in order to generate the evidence required to build and refine models and explanations.	Design investigations, collect evidence, analyze data, and evaluate evidence to determine measures of central tendencies, causal/correlational relationships, and anomalous data. **(5.1.12.B.1)**

Instructional Focus:
- Asking a question and deciding what to measure in order to answer the question
- Developing strategies for obtaining measurements, then systematically collecting data
- Structuring the gathered data, then interpreting and evaluating the data
- Using the empirical results to determine causal/correlational relationships

Content Statement	Cumulative Progress Indicator
Mathematical tools and technology are used to gather, analyze, and communicate results.	Build, refine, and represent evidence-based models using mathematical, physical, and computational tools. **(5.1.12.B.2)**

Instructional Focus:
- Using mathematics in the collection and treatment of data and in the reasoning used to develop concepts, laws and theories
- Using tools of data analysis to organize data and formulate hypotheses for further testing
- Using existing mathematical, physical, and computational models to analyze and communicate findings

Content Statement	Cumulative Progress Indicator
Empirical evidence is used to construct and defend arguments.	Revise predictions and explanations using evidence, and connect explanations/arguments to established scientific knowledge, models, and theories. **(5.1.12.B.3)**

Instructional Focus:
- Making claims based on the available evidence
- Explaining the reasoning, citing evidence, behind a proposed claim
- Connecting the claim to established concepts and principles

Content Statement	Cumulative Progress Indicator
Scientific reasoning is used to evaluate and interpret data patterns and scientific conclusions.	Develop quality controls to examine data sets and to examine evidence as a means of generating and reviewing explanations. **(5.1.12.B.4)**

Instructional Focus:

- Analyzing experimental data sets using measures of central tendency
- Representing and describing mathematical relationships among variables using graphs and tables
- Using mathematical tools to construct and evaluate claims

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.

C. Reflect on Scientific Knowledge: Scientific knowledge builds on itself over time.

Essential Question	Enduring Understanding
How is scientific knowledge constructed?	Scientific knowledge builds upon itself over time.

Content Statement	Cumulative Progress Indicator
Refinement of understandings, explanations, and models occurs as new evidence is incorporated.	Reflect on and revise understandings as new evidence emerges. **(5.1.12.C.1)**

Instructional Focus:

- Reflecting on the status of one's own thinking and learning (i.e. uncovering how a student knows what they know and why)
- Understanding that scientific knowledge can be revised as new evidence emerges

Content Statement	Cumulative Progress Indicator
Data and refined models are used to revise predictions and explanations.	Use data representations and new models to revise predictions and explanations. **(5.1.12.C.2)**

Instructional Focus:

- Recognizing that predictions or explanations can be revised on the basis of seeing new data and evidence
- Using data and evidence to modify and extend investigations
- Understanding that explanations are increasingly valuable as they account for the available evidence more completely

Content Statement	Cumulative Progress Indicator
Science is a practice in which an established body of knowledge is continually revised, refined, and extended as new evidence emerges.	Consider alternative theories to interpret and evaluate evidence-based arguments. **(5.1.12.C.3)**

Instructional Focus:

- Understanding that there might be multiple interpretations of the same phenomena
- Stepping back from evidence and explanations to consider whether another interpretation of a particular finding is plausible with respect to existing scientific evidence
- Considering alternative perspectives worthy of further investigations

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.

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.

Essential Question	Enduring Understanding
How does scientific knowledge benefit – deepen and broaden - from scientists sharing and debating ideas and information with peers?	The growth of scientific knowledge involves critique and communication - social practices that are governed by a core set of values and norms.

Content Statement	Cumulative Progress Indicator
Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.	Engage in multiple forms of discussion in order to process, make sense of, and learn from others' ideas, observations, and experiences. **(5.1.12.D.1)**

Instructional Focus:

- Seeing oneself as an effective participant and contributor in science
- Interacting with others to test new ideas, soliciting and providing feedback, articulating and evaluating emerging explanations, developing shared representations and models, and reaching consensus
- Developing a sense of appropriate trust and skepticism when evaluating others' claims, evidence and reasoning

Content Statement	Cumulative Progress Indicator
Science involves using language, both oral and written, as a tool for making thinking public.	Represent ideas using literal representations, such as graphs, tables, journals, concept maps, and diagrams. **(5.1.12.D.2)**

Instructional Focus:

- Constructing literal representations from empirical evidence and observations
- Presenting and defending a scientific argument using literal representations
- Evaluating others' literal representations for consistency with their claims, evidence and reasoning
- Moving fluently between representations such as graphs, data, equations, diagrams and verbal explanations

Content Statement	Cumulative Progress Indicator
Ensure that instruments and specimens are properly cared for and that animals, when used, are treated humanely, responsibly, and ethically.	Demonstrate how to use scientific tools and instruments and knowledge of how to handle animals with respect for their safety and welfare. **(5.1.12.D.3)**

Instructional Focus:

- Selecting and using appropriate instrumentation to design and conduct investigations
- Understanding, evaluating and practicing safe procedures for conducting science investigations
- Demonstrating appropriate digital citizenship (i.e., cyber-safety and cyber-ethics) when accessing scientific data from collaborative spaces. (See NJCCCS 8.1 and 9.1)
- Ensuring that living organisms are properly cared for and treated humanely, responsibly, and ethically