PUBLIC SCHOOLS OF EDISON TOWNSHIP
OFFICE OF CURRICULUM AND INSTRUCTION

Course Name: Biology

<table>
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<tr>
<th>Length of Course:</th>
<th>1 year</th>
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<tr>
<td>Elective/Required:</td>
<td>Required</td>
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<tr>
<td>Schools:</td>
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<tr>
<td>Eligibility:</td>
<td>Grades 9, 10</td>
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<tr>
<td>Credit Value: (High School Only)</td>
<td>6</td>
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Statement of Purpose

Biology is offered to ninth and tenth graders as part of a sequence of college preparatory, laboratory science courses. It is preceded in that sequence by Environmental Science and, traditionally, followed by Chemistry and Physics. The course presents a comprehensive survey of the life sciences at a level appropriate to its intended audience. The course content is based on the most current New Jersey Core Curriculum Content Standards for science, including science practices. In addition, it connects the subject matter to everyday experiences, life science careers and environmental concerns.

This curriculum guide was compiled in the year of 2015 and revised in 2016 it is designed to follow NGSS/NJSLS and utilize existing course materials, Discovery Education Science Tech Book, and online resources.

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Kay Lewis- Edison High School

Coordinated by:
Laurie Maier - Supervisor of Science
Course Objectives

By the end of the Biology course, students will be able to:

- **(NJSLS/HS-LS1-1)** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. (Quarter 2)
- **(NJSLS/HS-LS1-2)** Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. (Quarter 1)
- **(NJSLS/HS-LS1-3)** Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. (Quarter 1)
- **(NJSLS/HS-LS1-4)** Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. (Quarter 3)
- **(NJSLS/HS-LS1-5)** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. (Quarter 2)
- **(NJSLS/HS-LS1-6)** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. (Quarter 1)
- **(NJSLS/HS-LS1-7)** Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. (Quarter 2)
- **(NJSLS/HS-LS2-1)** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (Quarter 4)
- **(NJSLS/HS-LS2-2)** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. (Quarter 4)
- **(NJSLS/HS-LS2-3)** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. (Quarters 2)
- **(NJSLS/HS-LS2-4)** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. (Quarters 4)
- **(NJSLS/HS-LS2-5)** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. (Quarters 2)
- **(NJSLS/HS-LS2-6)** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. (Quarter 4)
Course Objectives (cont.)

- (NJSLS/HS-LS2-7) Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. (Quarter 4)
- (NJSLS/HS-LS2-8) Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce. (Quarter 4)
- (NJSLS/HS-LS3-1) Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. (Quarters 2, 3)
- (NJSLS/HS-LS3-2) Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. (Quarter 2, 3)
- (NJSLS/HS-LS3-3) Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. (Quarters 3, 4)
- (NJSLS/HS-LS4-1) Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. (Quarter 4)
- (NJSLS/HS-LS4-2) Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. (Quarter 4)
- (NJSLS/HS-LS4-3) Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. (Quarter 4)
- (NJSLS/HS-LS4-4) Construct an explanation based on evidence for how natural selection leads to adaptation of populations. (Quarter 4)
- (NJSLS/HS-LS4-5) Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. (Quarter 4)
- (NJSLS/HS-LS4-6) Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. (Quarter 4)
- (NJSLS/HS-ESS2-5) Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. (Quarter 1)
- (NJSLS/HS-ESS2-6) Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. (Quarter 2)
- (NJSLS/HS-ESS2-7) Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth. (Quarter 4)
- (NJSLS/HS-ESS3-1) Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. (Quarter 4)
Course Objectives (cont.)

- **(NJSLS/HS-ESS3-3)** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. (Quarter 4)
- **(NJSLS/HS-ESS3-4)** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. (Quarter 4)
- **(NJSLS/HS-ESS3-5)** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. (Quarter 4)
- **(NJSLS/HS-ESS3-6)** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. (Quarter 4)

**Engineering Design**

- **(NJSLS/HS-ETS1-1)** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- **(NJSLS/HS-ETS1-2)** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- **(NJSLS/HS-ETS1-3)** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- **(NJSLS/HS-ETS1-4)** Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Timeline

First Quarter Units - Unit 1: Structure and Function
   Characteristics of Living Things (Including Hierarchy within Organisms)
   Chemistry of Life
   Homeostasis
   Membrane Transport

Second Quarter Units - Unit 2: Cell Specialization
   Cell Structure
   Photosynthesis
   Cellular Respiration
   DNA replication
   Protein Synthesis

Third Quarter Units- Unit 3: Cellular Reproduction and Inheritance
   Mitosis
   Meiosis
   Genetics

Fourth Quarter Units - Unit 4: Evolution and Ecology
   Evolution
      ● Evidence of Evolution
      ● Natural Selection
      ● Frequency of Traits in an Environment
   Ecology
      ● Energy Transformations
      ● Population Ecology
      ● Biogeochemical Cycles (Carbon, Nitrogen, Water)
      ● Group Behavior Impacts an Environment
      ● Human Activity and Climate
      ● Human Activity and Biodiversity (Including Succession)
Unit 1: Structure and Function

**Essential Questions:** Phenomena: Homeostasis and Metabolic Disorders

- How do the structures of molecules enable life’s functions?
- How are life’s functions adjusted as a result of molecules (Homeostasis)?

**NGSS Performance Expectations:** (Students who demonstrate understanding can:)

- NJSLS/HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms
- NJSLS/HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- NJSLS/HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- NJSLS/HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

**Unit Assessment:** (What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)

- Quarterly
- Disruption of Homeostasis- Students will research and conduct experiments to study the effect of changes in the environment or cell structures on the response of an organism. Examples may include heart rate response to exercise, stomate response to moisture and temperature, root development in response to water levels, or research metabolic disorders.

**Resources:**

**Essential Materials, Supplementary Materials, Links to Best Practices**

- Discovery Education Science Tech Book
- Holt Biology
- Prentice Hall Biology
- Holt Modern Biology
- For phenomena ideas: www.NGSSPhenomena.com
- For simulation labs: https://concord.org/stem-resources/subject/biology
- For readings, quizzes, and simulations: www.ck12.org
### Student Learning Objectives: (SLO)

NJSLS/HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms

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<th>Disciplinary Core Ideas</th>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts</th>
<th>Instructional Actions</th>
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<tbody>
<tr>
<td>LS1.A: Structure and Function</td>
<td>Developing and using models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds</td>
<td>System and System Models: Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.</td>
<td>Discovery Education Science Tech Book Under Biology Unit –Cells ● Cell Structure and Function Identify /diagram nested levels of hierarchical structural organization Apply those diagrams to specific human systems</td>
</tr>
</tbody>
</table>

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.

**Assessment Boundary:** Assessment does not include interactions and functions at the molecular or chemical reaction level. This objective will also be met in Unit 2, where transcription and translation will be discussed in further detail.
### Unit 1: Structure and Function (cont.)

#### Student Learning Objectives: (SLO)

NJSLS/HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

#### Disciplinary Core Ideas

**LS1.A: Structure and Function**

Feedback mechanisms maintain a living system’s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

#### Science and Engineering Practices

**Planning and Carrying Out Investigations**

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

**Connections to Nature of Science Scientific Investigations Use a Variety of Methods**

Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings.

#### Crosscutting Concepts

**Stability and Change**

Feedback (negative or positive) can stabilize or destabilize a system.

#### Instructional Actions

**Discovery Education Science Tech Book Under Biology**

Unit – Animals
- Homeostasis
Unit - The chemistry of Living Things
- Atoms, Elements, Compounds, and Chemical Bonds
- Water
- Chemical Reactions
- Acids and bases
- The Chemistry of Life

Diagram/analyze feedback loops

Enzyme lab

Homeostasis/Organism response investigation (can be done as unit assessment)

**Assessment Boundary:** Assessment does not include the cellular processes involved in the feedback mechanism.
## Unit 1: Structure and Function (cont.)

### Student Learning Objectives: (SLO)

**NJSLS/HS-LS1-6:** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

### Disciplinary Core Ideas

**LS1.C: Organization for Matter and Energy Flow in Organisms**

The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.

As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.

### Science and Engineering Practices

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

### Crosscutting Concepts

**Energy and Matter**

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

### Instructional Actions

**Discovery Education Science Tech Book Under Biology**

Unit - The chemistry of Living Things

- Atoms, Elements, Compounds, and Chemical Bonds
- Water
- Chemical Reactions
- Acids and bases

Test foods for macromolecules

Building blocks for macromolecules activity

### Assessment Check Points

Tests
Quizzes
Formative Assessments
Labs/Activities
Homework

### Instructional Adjustments:

Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on using evidence from models and simulations to support explanations.

**Assessment Boundary:** Assessment does not include the details of the specific chemical reactions or identification of macromolecules.
### Unit 1: Structure and Function (cont.)

#### Student Learning Objectives: (SLO)

**NJSLS/HS-ESS2-5**: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

#### Disciplinary Core Ideas

**ESS2.C: The Roles of Water in Earth’s Surface Processes**

The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet’s dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
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<th>Instructional Actions</th>
<th>Activities/Strategies</th>
<th>Assessment Check Points</th>
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<tbody>
<tr>
<td>Planning and Carrying Out Investigations</td>
<td>Structure and Function</td>
<td>Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.</td>
<td>Discovery Education Science Tech Book Under Biology</td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
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</table>
| The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. | Unit - The chemistry of Living Things  
- Atoms, Elements, Compounds, and Chemical Bonds  
- Water  
- Chemical Reactions  
- Acids and bases | Properties of Water activity  
pH activity | | |

#### Instructional Adjustments:

Modifications, student difficulties, possible misunderstandings

#### Clarification Statement:

Emphasis is on using evidence from models and simulations to support explanations.

#### Assessment Boundary:

Assessment does not include the details of the specific chemical reactions or identification of macromolecules.
### Unit 2: Cell Specialization

#### Essential Questions: Overarching Phenomena of interest: Cells meet the demands of organisms
- How do the structures of cells enable life’s functions?
- How does information coded in DNA result in proteins?

#### NGSS Performance Expectations: (Students who demonstrate understanding can:)
- NJSLS/HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- NJSLS/HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
- NJSLS/HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
- NJSLS/HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
- NJSLS/HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- NJSLS/HS-ESS2-6 Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- NJSLS/HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

#### Unit Assessment: (What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)
- Quarterly
- Design an experiment to test the effect of a variable on cellular respiration or photosynthesis, including mathematical representations

#### Resources:
**Essential Materials, Supplementary Materials, Links to Best Practices**
- Discovery Education Science Tech Book
- Holt Biology
- Prentice Hall Biology
- Holt Modern Biology
- For phenomena ideas: www.NGSSPhenomena.com
- For simulation labs: https://concord.org/stem-resources/subject/biology
- For readings, quizzes, and simulations: www.ck12.org
## Unit 2: Cell Specialization (cont.)

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<th>Student Learning Objectives: (SLO)</th>
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<tr>
<td>NJSLS/HS-LS1-1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.</td>
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### Disciplinary Core Ideas

**LS1.A: Structure and Function**

Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (Note: This Disciplinary Core Idea is also addressed by NJSLS/HS-LS3-1.

### Science and Engineering Practices

- **Constructing Explanations and Designing Solutions**
  - Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
  - Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

### Crosscutting Concepts

**Structure and Function**

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

### Activities/Strategies

**Discovery Education Science Tech Book Under Biology Unit – Cells**

- Cell Structure and Function
- Cell Division
- Cell Transport
- Asexual and Sexual Reproduction

### Assessment Check Points

- Modeling of transcription/translation
- Tests
- Quizzes
- Formative Assessments
- Labs/Activities
- Homework

### Instructional Adjustments:

**Modifications, student difficulties, possible misunderstandings**

**Clarification Statement:** Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.

**Assessment Boundary:** Assessment does not include interactions and functions at the molecular or chemical reaction level.
### Unit 2: Cell Specialization (cont.)

#### Student Learning Objectives (SLO)

**NJSLS/HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

#### Instructional Actions

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<td>LS1.C: Organization for Matter and Energy Flow in Organisms</td>
<td>Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model based on evidence to illustrate the relationships between systems or between components of a system. (NJSLS/HS-LS1-5)</td>
<td>Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.</td>
<td>Discovery Education Science Tech Book Under Biology Unit - Energy and Life Photosynthesis activity and/or lab (can be used for unit assessment) Diagram or physical representation (ball and stick) to show the movement of carbons in photosynthesis (Level 1 and Honors)</td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
</tr>
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</table>

#### Instructional Adjustments:

Modifications, student difficulties, possible misunderstandings

#### Clarification Statement:

Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.

#### Assessment Boundary:

Assessment does not include specific biochemical steps.
### Unit 2: Cell Specialization (cont.)

**Student Learning Objectives:** (SLO)

NJSLS/HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

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<td>Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Use a model based on evidence to illustrate the relationships between systems or between components of a system. (NJSLS/HS-LS1-5),(NJSLS/HS-LS1-7)</td>
<td>Energy and Matter Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (NJSLS/HS-LS1-7),(NJSLS/HS-LS2-4)</td>
<td>Discovery Education Science Tech Book Under Biology Unit- Energy and Life • Cellular Respiration • Energy for Life Respiration activity and/or lab (can be used for unit assessment) Diagram or physical representation(ball and stick) to show the movement of carbons in respiration (Honors and level 1)</td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
</tr>
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</table>

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.

**Assessment Boundary:** Assessment should not include identification of the steps or specific processes involved in cellular respiration.
Student Learning Objectives: (SLO)
NJSLS/HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

### Disciplinary Core Ideas

**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**

Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (NJSLS/HS-LS2-3)

### Science and Engineering Practices

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (NJSLS/HS-LS1-6), (NJSLS/HS-LS2-3)

**Scientific Knowledge is Open to Revision in Light of New Evidence**

Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (NJSLS/HS-LS2-3)

### Crosscutting Concepts

**Energy and Matter**

Energy drives the cycling of matter within and between systems. (NJSLS/HS-LS2-3)

### Activities/Strategies

**Discovery Education Science Tech Book Under Biology**

- Unit: Energy and Life
  - Cellular Respiration
  - Photosynthesis
  - Energy for Life
  - Aerobic vs. Anaerobic respiration comparison

### Assessment Check Points

Tests
Quizzes
Formative Assessments
Labs/Activities
Homework

**Instructional Adjustments**: Modifications, student difficulties, possible misunderstandings

**Clarification Statement**: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.

**Assessment Boundary**: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.
### Unit 2: Cell Specialization (cont.)

#### Student Learning Objectives: (SLO)

NJSLS/HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

#### Disciplinary Core Ideas

**LS2.B: Cycles of Matter and Energy Transfer in Ecosystems**

Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (NJSLS/HS-LS2-5)

**PS3.D: Energy in Chemical Processes**

The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. (secondary to NJSLS/HS-LS2-5)

#### Science and Engineering Practices

**Developing and Using Models**

- Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (NJSLS/HS-LS2-5)

**Crosscutting Concepts**

**Systems and System Models**

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (NJSLS/HS-LS2-5)

#### Instructional Actions

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Examples of models could include simulations and mathematical models.

**Assessment Boundary:** Assessment does not include the specific chemical steps of photosynthesis and respiration.
### Unit 2: Cell Specialization (cont.)

<table>
<thead>
<tr>
<th>Student Learning Objectives: (SLO)</th>
<th>Instructional Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJSLS/HS-ESS2-6 Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.</td>
<td><strong>Instructional Adjustments:</strong> Modifications, student difficulties, possible misunderstandings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disciplinary Core Ideas</th>
<th>Science and Engineering Practices</th>
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<th>Activities/Strategies</th>
<th>Assessment Check Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.</td>
<td>Developing and Using Models Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s). Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (NJLS/HS-ESS2-1),(NJLS/HS-ESS2-3),(NJLS/HS-ESS2-6)</td>
<td>The total amount of energy and matter in closed systems is conserved.</td>
<td><strong>Discovery Education</strong> Science Tech Book Under Biology Unit- Energy and Life  - Photosynthesis  - Cellular Respiration  - Energy for Life Unit – Ecology  - Nutrient Cycles Model the carbon cycle Evaluate how changes to the carbon cycle impact chemical, physical, geological and biological processes</td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
</tr>
</tbody>
</table>

**Clarification Statement:** Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.
**Unit 2: Cell Specialization (cont.)**

**Student Learning Objectives:** (SLO)
NJSLS/HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

<table>
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</thead>
<tbody>
<tr>
<td><strong>LS1.A: Structure and Function</strong></td>
<td><strong>Asking Questions and Defining Problems</strong></td>
<td><strong>Cause and Effect</strong></td>
<td><strong>Discovery Education</strong></td>
<td><strong>Tests</strong></td>
</tr>
</tbody>
</table>
| All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (Note: This Disciplinary Core Idea is also addressed by NJSLS/HS-LS1-1.) | Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining and evaluating empirically testable questions and design problems using models and simulations. | Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. | **Science Tech Book Under Biology** Unit- Heredity  
- Genetics  
- DNA  
- Transcription and Translation  
- Genetic Disorders and Technology  
- Genetic Technology Protein Synthesis activity | **Quizzes**  
**Formative Assessments**  
**Labs/Activities Homework** |

| **LS3.A: Inheritance of Traits** | **Asking Questions and Defining Problems** | **Cause and Effect** | **Discovery Education** | **Tests** |
| Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species’ characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. | Asking questions that arise from examining models or a theory to clarify relationships. | Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. | **Science Tech Book Under Biology** Unit- Heredity  
- Genetics  
- DNA  
- Transcription and Translation  
- Genetic Disorders and Technology  
- Genetic Technology Protein Synthesis activity | **Quizzes**  
**Formative Assessments**  
**Labs/Activities Homework** |

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.
### Unit 2: Cell Specialization (cont.)

**Student Learning Objectives:** (SLO)

NJSLS/HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from:
1. new genetic combinations through meiosis,
2. viable errors occurring during replication, and/or
3. mutations caused by environmental factors.

**Disciplinary Core Ideas**

- **LS3.B: Variation of Traits**

  In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.

  Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.

**Science and Engineering Practices**

- **Engaging in Arguments from Evidence**

  Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

  Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence.

**Crosscutting Concepts**

- **Cause and Effect**

  Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Instructional Actions**

- **Activities/Strategies**

  Discovery Education Science Tech Book Under Biology
  - Unit –Cells
    - Cell Structure and Function
    - Cell Division
  - Unit- Heredity
    - DNA
    - Transcription and Translation
  - Cause and effect of mutations

- **Assessment Check Points**

  Tests
  Quizzes
  Formative Assessments
  Labs/Activities
  Homework

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on using data to support arguments for the way variation occurs.

**Assessment Boundary:** Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.
## Unit 3: Cellular Reproduction and Inheritance

### Essential Questions:
Overarching Phenomenon of Interest: Heredity
- How are the characteristics from one generation related to the previous generation?
- How does genetic information result in physical characteristics

### NGSS Performance Expectations:
(Students who demonstrate understanding can:)
- NJSLS/HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- NJSLS/HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
- NJSLS/HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
- NJSLS/HS-LS1-4 Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

### Unit Assessment:
(What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)
- Quarterly
- Students will research a genetic disorder/ trait or prepare a model of how genes are inherited over several generations

### Resources:
**Essential Materials, Supplementary Materials, Links to Best Practices**
- Discovery Education Science Tech Book
- Holt Biology
- Prentice Hall Biology
- Holt Modern Biology
- For phenomena ideas: www.NGSSPhenomena.com
- For simulation labs: https://concord.org/stem-resources/subject/biology
- For readings, quizzes, and simulations: www.ck12.org
### Unit 3: Cellular Reproduction and Inheritance (cont.)

#### Student Learning Objectives: (SLO)

NJSLS/HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

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</table>
| **LS1.A: Structure and Function** | Asking Questions and Defining Problems  
Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining and evaluating empirically testable questions and design problems using models and simulations. | Cause and Effect  
Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. | Discourse Education Science Tech Book Under Biology  
Unit- Heredity  
- Genetics  
- DNA  
- Genetic Disorders and Technology  
- Genetic Technology  
Punnett square problems and activities | Tests  
Quizzes  
Formative Assessments  
Labs/Activities  
Homework |
| **LS3.A: Inheritance of Traits** | Ask questions that arise from examining models or a theory to clarify relationships. | | | |

#### Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

**Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.**
### Unit 3: Cellular Reproduction and Inheritance (cont.)

#### Student Learning Objectives: (SLO)

NJSLS/HS-LS3-2 Make and defend a claim based on evidence that inheritable genetic variations may result from:
1. new genetic combinations through meiosis,
2. viable errors occurring during replication,
3. mutations caused by environmental factors.

#### Disciplinary Core Ideas

**LS3.B: Variation of Traits**

In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.

Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.

#### Science and Engineering Practices

**Engaging in Arguments from Evidence**

Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

**Cause and Effect**

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Make and defend a claim based on evidence about the natural world that reflects scientific knowledge and student-generated evidence.**

#### Crosscutting Concepts

**Cause and Effect**

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

**Discovery Education Science Tech Book Under Biology**

Unit- Heredity
- Genetics
- DNA

Unit –Cells
- Cell Division
- Asexual and Sexual Reproduction
- Mitosis/Meiosis modeling

Cause and effect of mutations

Cancer activity/ discussion

#### Instructional Actions

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on using data to support arguments for the way variation occurs.

**Assessment Boundary:** Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.
## Unit 3: Cellular Reproduction and Inheritance (cont.)

### Student Learning Objectives: (SLO)

NJSLS/HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

### Instructional Actions

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>LS3.B: Variation of Traits</td>
<td>Analyzing and Interpreting Data</td>
<td>Scale, Proportion, and Quantity</td>
<td>Discovery Education Science Tech Book Under Biology</td>
<td>Tests, Quizzes, Formative Assessments, Labs/Activities, Homework</td>
</tr>
<tr>
<td>Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.</td>
<td>Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.</td>
<td>Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).</td>
<td>Unit- Heredity – Genetics, Genetic Disorders and Technology, Genetic Technology</td>
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<td>Connections to Nature of Science Science is a Human Endeavor</td>
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<td>Human genetics lab activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technological advances have influenced the progress of science and science has influenced advances in technology. Science and engineering are influenced by society and society is influenced by science and engineering.</td>
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</tr>
</tbody>
</table>

### Instructional Adjustments:

Modifications, student difficulties, possible misunderstandings

### Clarification Statement:

Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.

### Assessment Boundary:

Assessment does not include Hardy-Weinberg calculations.
Unit 4: Evolution and Ecology

**Essential Questions:** Overarching Phenomena of Interest: Factors that alter the balance of an ecosystem.

- How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms?
- How do organisms obtain and use energy they need to live and grow?
- How do matter and energy move through ecosystems?
- How do organisms interact with the living and non-living environment to obtain matter and energy?
- How does biodiversity affect humans? How do humans affect biodiversity?
- How do humans impact our environment?

**NGSS Performance Expectations:** (Students who demonstrate understanding can):

- NJSLS/HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- NJSLS/HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- NJSLS/HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- NJSLS/HS-LS2-6 Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- NJSLS/HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- NJSLS/HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- NJSLS/HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. (Revisited in honors classes only)
- NJSLS/HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
- NJSLS/HS-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
- NJSLS/HS-LS4-3 Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- NJSLS/HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
- NJSLS/HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
- NJSLS/HS-LS4-6 Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- NJSLS/HS-ESS-2-7 Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.
- NJSLS/HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- NJSLS/HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- NJSLS/HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
Unit 4: Evolution and Ecology (cont.)

- NJSSLS/HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Unit Assessment: (What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)
- Quarterly

Resources:

Essential Materials, Supplementary Materials, Links to Best Practices
- Discovery Education Science Tech Book
- Holt Biology
- Prentice Hall Biology
- Holt Modern Biology
- For phenomena ideas: www.NGSSPhenomena.com
- For simulation labs: https://concord.org/stem-resources/subject/biology
- For readings, quizzes, and simulations: www.ck12.org
### Student Learning Objectives: (SLO)

NJSLS/HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

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<tbody>
<tr>
<td>LS2.A: Interdependent Relationships in Ecosystems</td>
<td>Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (NJSLS/HS-LS2-1)</td>
<td>Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (NJSLS/HS-LS2-1)</td>
<td>Discovery Education Science Tech Book Under Biology Unit – Ecology • Describing Populations • Ecosystems • Nutrient cycles Carrying capacity activity with data calculation</td>
</tr>
</tbody>
</table>

### Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.

**Assessment Boundary:** Assessment does not include deriving mathematical equations to make comparisons.
Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives:** (SLO)

NJSLS/HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

<table>
<thead>
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<tbody>
<tr>
<td><strong>LS2.A: Interdependent Relationships in Ecosystems</strong></td>
<td>Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, data. exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Use mathematical representations of phenomena or design solutions to support and revise explanations. (NJSLS/HS-LS2-2)</td>
<td>Scale, Proportion, and Quantity Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (NJSLS/HS-LS2-2)</td>
<td>Discovery Education Science Tech Book Under Biology Unit – Ecology  - Describing Populations  - Ecosystems  - Nutrient Cycles Analyze data and news articles related to biodiversity in local and global ecosystems</td>
</tr>
</tbody>
</table>
**Unit 4: Evolution and Ecology (cont.)**

| durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (NJSLS/HS-LS2-2) |

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.

**Assessment Boundary:** Assessment is limited to provided data.
## Student Learning Objectives: (SLO)

NJSLS/HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

### Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
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<tbody>
<tr>
<td>LS2.B: Cycles of Matter and Energy Transfer in Ecosystems</td>
<td>Energy and Matter</td>
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</tbody>
</table>

Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (NJSLS/HS-LS2-4)

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use mathematical representations of phenomena or design solutions to support claims. (NJSLS/HS-LS2-4)

### Instructional Actions

<table>
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<tr>
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<tr>
<td>Discovery Education Science Tech Book Under Biology</td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
</tr>
</tbody>
</table>

### Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.

Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.
**Unit 4: Evolution and Ecology (cont.)**

<table>
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<th><strong>Student Learning Objectives:</strong> (SLO)</th>
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<tbody>
<tr>
<td>NJSLS/HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.</td>
<td><strong>Engaging in Argument from Evidence</strong></td>
</tr>
<tr>
<td><strong>Disciplinary Core Ideas</strong></td>
<td><strong>Science and Engineering Practices</strong></td>
</tr>
<tr>
<td>A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (NJSLS/HS-LS2-2),(NJSLS/HS-LS2-6)</td>
<td>Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.</td>
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**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.
### Student Learning Objectives: (SLO)

**NJSLS/HS-LS2-7**: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

<table>
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<tbody>
<tr>
<td><strong>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</strong></td>
<td>Constructing Explanations and Designing Solutions</td>
<td>Stability and Change</td>
<td>Discovery Education Science Tech Book Under Biology</td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
</tr>
<tr>
<td>Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (NJSLS/HS-LS2-7)</td>
<td>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</td>
<td>Much of science deals with constructing explanations of how things change and how they remain stable. (NJSLS/HS-LS2-6),(NJSLS/HS-LS2-7)</td>
<td>Unit- Heredity • Evolution Unit- Diversity of Living Things • Classification • The History of Life on Earth Unit – Ecology • Describing Populations • Ecosystems • Nutrient Cycles Activities on how to minimize/remove human impact. Evaluate how changes to the carbon cycle impact chemical, physical, geological and biological processes</td>
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</tr>
<tr>
<td><strong>LS4.D: Biodiversity and Humans</strong></td>
<td>Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (NJSLS/HS-LS2-7)</td>
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**Unit 4: Evolution and Ecology (cont.)**

and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(secondary to NJSLS/HS-LS2-7), (NJSLS/HS-LS4-6).*

**ETS1.B: Developing Possible Solutions**

When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary to NJSLS/HS-LS2-7), (secondary to NJSLS/HS-LS4-6)*

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Examples of human activities can include urbanization, building dams, and dissemination of invasive species.
## Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives:** (SLO)
NJSLS/HS-LS2-8: Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce.

<table>
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<th>Disciplinary Core Ideas</th>
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</tr>
</thead>
</table>

Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.

- Engaging in Argument from Evidence
  - Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
  - Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.

**Connections to Nature of Science**

- Scientific Knowledge is Open to Revision in Light of New Evidence
  - Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.
### Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives:** (SLO)

NJSLS/HS-LS3-3 Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

(This concept is revisited from Unit 2 in Honors classes only)

<table>
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</tr>
</thead>
</table>
| **LS3.B: Variation of Traits** | Analyzing and Interpreting Data  
Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.  
Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (NJSLS/HS-LS3-3) | Scale, Proportion, and Quantity  
Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (NJSLS/HS-LS3-3)  
Science is a Human Endeavor  
Technological advances have influenced the progress of science and science has influenced advances in technology. (NJSLS/HS-LS3-3)  
Science and engineering are influenced by society and society is influenced by science and engineering. (NJSLS/HS-LS3-3) | Discovery Education  
Science Tech Book  
Under Biology  
Unit- Heredity  
- Genetics  
- DNA  
- Transcription and Translation  
- Genetic Disorders and Technology  
- Genetic Technology  
- Evolution  
Activity on how selective pressure contributes to genetic variation  
Activity on the role of environment and genetics on distribution of traits | Tests  
Quizzes  
Formative Assessments  
Labs/Activities  
Homework |

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.

**Assessment Boundary:** Assessment does not include Hardy-Weinberg calculations.
# Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives:** (SLO)

NJSLS/HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

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<th>Activities/Strategies</th>
<th>Assessment Check Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LS4.A: Evidence of Common Ancestry and Diversity</strong></td>
<td>Obtaining, Evaluating, and Communicating Information</td>
<td>Patterns</td>
<td><strong>Discovery Education Science Tech Book Under Biology</strong></td>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
<td></td>
</tr>
<tr>
<td>Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.</td>
<td>Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).</td>
<td>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. <strong>Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems</strong> Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</td>
<td>Discovery Education Science Tech Book Under Biology Unit- Heredity • Genetics • DNA • Transcription and Translation • Genetic Disorders and Technology • Genetic Technology • Evolution Evidence for Evolution activities (ex: homologous structures, embryology, fossil record, molecular evidence ...)</td>
<td>Apply amino acid sequences to evolution</td>
<td></td>
</tr>
</tbody>
</table>
confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.
Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives: (SLO)**
NJSLS/HS-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

### Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>LS4.B: Natural Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LS4.C: Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.</td>
</tr>
</tbody>
</table>

### Science and Engineering Practices

<table>
<thead>
<tr>
<th>Constructing Explanations and Designing Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</td>
</tr>
</tbody>
</table>

### Crosscutting Concepts

<table>
<thead>
<tr>
<th>Cause and Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
</tr>
</tbody>
</table>

### Instructional Actions

<table>
<thead>
<tr>
<th>Discovery Education Science Tech Book Under Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit- Heredity • Evolution Interpreting graphs</td>
</tr>
<tr>
<td>Pest management &amp; natural selection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment Check Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests Quizzes Formative Assessments Labs/Activities Homework</td>
</tr>
</tbody>
</table>
### Unit 4: Evolution and Ecology (cont.)

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on using evidence to explain the influence each of the four factors has on the number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.

**Assessment Boundary:** Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.
Student Learning Objectives: (SLO)
NJSL/HS-LS4-3: Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

Disciplinary Core Ideas
LS4.B: Natural Selection
Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information — that is, trait variation — that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.

LS4.C: Adaptation
Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change.

Instructional Adjustments: Modifications, student difficulties, possible misunderstandings
Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.
Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.
### Unit 4: Evolution and Ecology (cont.)

<table>
<thead>
<tr>
<th>Student Learning Objectives: (SLO)</th>
<th>Instructional Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NJSLS/HS-LS 4-4:</strong> Construct an explanation based on evidence for how natural selection leads to adaptation of populations.</td>
<td></td>
</tr>
</tbody>
</table>

#### Disciplinary Core Ideas

**LS4.C: Adaptation**

Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
<th>Crosscutting Concepts</th>
<th>Activities/Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Designing Solutions</strong></td>
<td><strong>Cause and Effect</strong></td>
<td><strong>Technology Implementation/Interdisciplinary Connections</strong></td>
</tr>
<tr>
<td>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</td>
<td>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
<td></td>
</tr>
<tr>
<td>Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world.</td>
<td><strong>Connections to Nature of Science: Scientific Knowledge Assumes an Order and Consistency in Natural Systems</strong></td>
<td><strong>Discovery Education Science Tech Book Under Biology</strong></td>
</tr>
</tbody>
</table>
| | Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. | Unit- Heredity  
  - Evolution  
  
Unit- Diversity of Living Things  
  - Classification  
  - The History of Life on Earth  
  
Natural Selection simulation |

#### Instructional Adjustments:

Modifications, student difficulties, possible misunderstandings

#### Clarification Statement:

Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.
Unit 4: Evolution and Ecology (cont.)

Student Learning Objectives: (SLO)
NJSL/HSL-LS4-5: Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Instructional Actions

<table>
<thead>
<tr>
<th>Disciplinary Core Ideas</th>
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<th>Activities/Strategies</th>
<th>Assessment Check Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science.</td>
<td>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</td>
<td>Unit- Heredity  ● Evolution  Unit Ecology  ● Describing Populations  ● Ecosystems  ● Nutrient Cycles  Evaluating impacts of environmental change on population - Evaluating a situation where the environment changes and hypothesizing the change to the population</td>
<td></td>
</tr>
</tbody>
</table>

Instructional Adjustments: Modifications, student difficulties, possible misunderstandings

Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.
<table>
<thead>
<tr>
<th>Student Learning Objectives: (SLO)</th>
<th>Instructional Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJSLS/HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.</td>
<td>Activities/Strategies Technology Implementation/Interdisciplinary Connections</td>
</tr>
<tr>
<td><strong>Disciplinary Core Ideas</strong></td>
<td><strong>Science and Engineering Practices</strong></td>
</tr>
<tr>
<td>LS4.C: Adaptation</td>
<td>Using Mathematics and Computational Thinking</td>
</tr>
<tr>
<td>Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species. (NJSLS/HS-LS4-6)</td>
<td>Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</td>
</tr>
<tr>
<td>LS4.D: Biodiversity and Humans</td>
<td>Create or revise a simulation of a phenomenon, designed device, process, or system. (NJSLS/HS-LS4-6)</td>
</tr>
<tr>
<td>Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to NJSLS/HS-LS2-7),(NJSLS/HS-LS4-6)</td>
<td>Activities on how to minimize/remove human impact. (Example: Have students create an environment including organisms, real or fictitious, and abiotic factors. Then introduce a disturbance to the environment and have students predict what will happen to abiotic and biotic aspects of their environment)</td>
</tr>
</tbody>
</table>
Unit 4: Evolution and Ecology (cont.)

ETS1.B: Developing Possible Solutions
When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary to NJSL/HS-LS2-7),*(secondary to NJSL/HS-LS4-6)*

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary to NJSL/HS-LS4-6)*

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.
### Unit 4: Evolution and Ecology (cont.)

#### Student Learning Objectives: (SLO)

NJSLA/HS-ESS2-7 Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.

#### Disciplinary Core Ideas

<table>
<thead>
<tr>
<th>ESS2.D: WEATHER AND CLIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>ESS2.E Biogeology</th>
</tr>
</thead>
<tbody>
<tr>
<td>● The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth’s surface and the life that exists on it.</td>
</tr>
</tbody>
</table>

#### Science and Engineering Practices

<table>
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<th>Engaging in Argument from Evidence</th>
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<td>Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.</td>
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<table>
<thead>
<tr>
<th>Stability and Change</th>
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<tbody>
<tr>
<td>● Much of science deals with constructing explanations of how things change and how they remain stable.</td>
</tr>
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</table>

#### Crosscutting Concepts

<table>
<thead>
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<th>Discovery Education</th>
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<tr>
<td>Science Tech Book</td>
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#### Instructional Actions

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<th>Activities/Strategies</th>
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<tbody>
<tr>
<td>Technology Implementation/Interdisciplinary Connections</td>
</tr>
</tbody>
</table>

#### Assessment Check Points

| Tests |
| Quizzes |
| Formative Assessments |
| Labs/Activities |
| Homework |

### Instructional Adjustments:

Modifications, student difficulties, possible misunderstandings

### Clarification Statement:

Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth’s other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth’s surface. Examples of include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.

### Assessment Boundary:

Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth’s other systems.
### Unit 4: Evolution and Ecology (cont.)

<table>
<thead>
<tr>
<th>Student Learning Objectives: (SLO)</th>
<th>Instructional Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJSLHS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.</td>
<td><strong>Activities/Strategies</strong> Technology Implementation/Interdisciplinary Connections</td>
</tr>
<tr>
<td>ESS3.A: Natural Resources</td>
<td></td>
</tr>
<tr>
<td>Resource availability has guided the development of human society.</td>
<td>Constructing Explanations and Designing Solutions</td>
</tr>
<tr>
<td>ESS3.B: Natural Hazards</td>
<td></td>
</tr>
<tr>
<td>Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations.</td>
<td>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student generated sources of evidence consistent with scientific knowledge, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students’ own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</td>
</tr>
</tbody>
</table>

### Instructional Adjustments:
Modifications, student difficulties, possible misunderstandings

### Clarification Statement:
Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.
### Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives:** (SLO)

NJSL/HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

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</thead>
</table>
| The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (NJSL/HS-ESS3-3) | Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Create a computational model or simulation of a phenomenon, designed device, process, or system. | Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. | Unit – Ecology  
- Ecosystems  
- Nutrient cycles | Tests Quizzes Formative Assessments Labs/Activities Homework |

### Instructional Adjustments:

**Modifications, student difficulties, possible misunderstandings**

### Clarification Statement:

Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.

### Assessment Boundary:

Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.
### Unit 4: Evolution and Ecology (cont.)

**Student Learning Objectives:** (SLO)

NJSLS/HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems

<table>
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</thead>
<tbody>
<tr>
<td><strong>ESS3.C: Human Impacts on Earth Systems</strong></td>
<td>Constructing Explanations and Designing Solutions</td>
<td>Stability and Change</td>
<td>Activities/Strategies Technology Implementation/ Interdisciplinary Connections</td>
</tr>
</tbody>
</table>
| Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (NJSLS/HS-ESS3-4) | Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student generated sources of evidence consistent with scientific knowledge, principles, and theories. | Feedback (negative or positive) can stabilize or destabilize a system. (HSESS3-4) | Discovery Education Science Tech Book Under Biology Unit – Ecology  
  - Ecosystems  
  - Nutrient Cycles |
| **ETS1.B: Developing Possible Solutions** | Stability and Change | Connections to Engineering, Technology, and Applications of Science | |
| When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to NJSLS/HS-ESS3-2),(secondary NJSLS/HS-ESS3-4) | Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (NJSLS/HS-ESS3-4) | Influence of Engineering, Technology, and Science on Society and the Natural World | |
| **Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings | | | |
| **Clarification Statement:** Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean) | | | |
## Unit 4: Evolution and Ecology (cont.)

<table>
<thead>
<tr>
<th>Student Learning Objectives: (SLO)</th>
<th>Instructional Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NJSLS/HS-ESS3-5</strong> Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.</td>
<td><strong>Activities/Strategies</strong> Technology Implementation/Interdisciplinary Connections</td>
</tr>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td><strong>ESS3.D: Global Climate Change</strong></td>
<td>Analyzing and Interpreting Data</td>
<td>Stability and Change</td>
<td>Discovery Education Science Tech Book Under Biology</td>
<td></td>
</tr>
</tbody>
</table>
| Through the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (NJSLS/HS-ESS3-5) | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using computational models in order to make valid and reliable scientific claims. | Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HSESS3-3),(NJSLS/HS-ESS3-5) | Unit – Ecology  
  - Ecosystems  
  - Nutrient Cycles | Tests  
  Quizzes  
  Formative Assessments  
  Labs/Activities  
  Homework |
| **Connections to Nature of Science** | **Scientific Investigations** | **Use a Variety of Methods** | **Use a Variety of Methods** |
| | | | |
| **Scientific Investigations** | Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. | Science investigations use diverse methods and do not always use the same set of procedures to obtain data. New technologies advance scientific knowledge. | Read and interpret data from source such as Mauna Loa (Carbon cycle) and evaluate human impact |
### Unit 4: Evolution and Ecology (cont.)

<table>
<thead>
<tr>
<th>Scientific Knowledge is Based on Empirical Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science knowledge is based on empirical evidence.</td>
</tr>
<tr>
<td>Science arguments are strengthened by multiple lines of evidence supporting a single explanation.</td>
</tr>
</tbody>
</table>

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).

**Assessment Boundary:** Assessment is limited to one example of a climate change and its associated impacts.
**Unit 4: Evolution and Ecology (cont.)**

<table>
<thead>
<tr>
<th>Student Learning Objectives: (SLO)</th>
<th>Instructional Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJSL5/HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</td>
<td></td>
</tr>
</tbody>
</table>

**Disciplinary Core Ideas**

**ESS2.D: Weather and Climate**

Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HSESS3-6)

**ESS3.D: Global Climate Change**

Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (NJLSHS/HS-ESS3-6)

**Science and Engineering Practices**

**Using Mathematics and Computational**

Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (NJLSHS/HS-ESS3-6)

**Crosscutting Concepts**

**Systems and System Models**

When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (NJLSHS/HS-ESS3-6)

**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings

**Clarification Statement:** Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.

**Assessment Boundary:** Assessment does not include running computational representations but is limited to using the published results of scientific computational models.