Science Department

Biology Curriculum

Scope and Sequence

Weeks (Based on a 56 minute block)	Unit	Guiding Concepts	Instructional Methods
September - November 30th	1 - From Molecules to Organisms: Structure and Function	Review: ➔ Scientific Method / Experimental Design / Microscopy, Measurement & graphical analysis Characteristics of Life Cell Structure & Function Cell differentiation & specialization Multicellular organization Biochemistry (functional roles of carbohydrates, lipids, proteins & enzymes, and nucleic acids) / Properties of Water Nutrition fundamentals Cell membrane structure & function Movement of molecules across a membrane Homeostasis & Feedback mechanisms	Modeled instruction Direct Lecture presentations Inquiry Laboratory investigations Teacher demonstrations Technology based instruction Cooperative grouping Audio & Visual presentations Informational Text Summaries Research Journaling/Science writing
December 1 - February 1	2 - Heredity: Inheritance and Variation in traits	DNA Structure & Function Cell Cycle (Mitosis) Nucleic Acids & Protein Synthesis Mutations Meiosis Fundamentals of Genetics (Punnett Squares: monohybrid, co-dominance, incomplete dominance, sex-linked traits, pedigree charts) Chromosomes & Inheritance Human Genetics & Disease Biotechnology	Modeled instruction Direct Lecture presentations Inquiry Laboratory investigations Teacher demonstrations Technology based instruction Cooperative grouping Audio & Visual presentations Informational Text Summaries Research Journaling/Science writing
February - 2 - March 15	3 - Biological Evolution: Common Ancestry & Natural Selection	Origin of Species Evolution: Theory & Evidence Darwin & Natural Selection Speciation Biological Adaptation Biodiversity Classification: Taxonomy, Phylogeny & dichotomous keys	Modeled instruction Direct Lecture presentations Inquiry Laboratory investigations Teacher demonstrations Technology based instruction Cooperative grouping Audio & Visual presentations Informational Text Summaries Research Journaling/Science writing

March 15 - April 15	4 - Matter & Energy: The Flow through Living Systems & Ecosystems	Photosynthesis & Chloroplast Structure Cellular Respiration & Mitochondria structure Cycles of Matter in Ecosystems Energy Transfer in Ecosystems: Food Chains, Food Webs, Ecology Pyramids	Modeled instruction Direct Lecture presentations Inquiry Laboratory investigations Teacher demonstrations Technology based instruction Cooperative grouping Audio & Visual presentations Informational Text Summaries Research Journaling/Science writing
April 16th - May 15th	5- Ecosystems: Interdependent Relationships & Dynamics	Species interactions & relationships (Symbiotic Relationships) Biomes and Climate Zones Niche, Habitat, and Adaptation Populations and population growth	Modeled instruction Direct Lecture presentations Inquiry Laboratory investigations Teacher demonstrations Technology based instruction Cooperative grouping Audio & Visual presentations Informational Text Summaries Research Journaling/Science writing
May 15th - June 15th	6 - Ecosystems: Human Impact on Climate and Biodiversity	Human activities and their impact on earth's systems Renewable / Non-renewable resources use & misuse Natural Disasters Cause/effect: Global Warming/ Climate Change Science & engineering solutions to reduce human impact on Earth's systems	Modeled instruction Direct Lecture presentations Inquiry Laboratory investigations Teacher demonstrations Technology based instruction Cooperative grouping Audio & Visual presentations Informational Text Summaries Research Journaling/Science writing

Unit 1

From Molecules to Organisms: Structure and Function

Summary and Rationale

This unit is based on the underlying principle that the cell is the basic unit of life. After a brief review of general scientific process and procedure including inquiry and experimentation, the focus shifts to investigating and formulating an answer to the question "*How do the structures of organisms enable life's functions?" S*tudents investigate, research and construct explanations for the structure and functions of cells as the basic unit of life, including the structural properties that define the biomolecules. Students will explore how the structure of DNA determines the structure of proteins and how proteins then carry out essential functions of life through systems of specialized cells. Students will develop and use models to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms, as well as investigate in order to provide evidence that feedback mechanisms maintain homeostasis.

The crosscutting concepts of *structure and function*, *matter and energy*, and *systems and system models* are called out as organizing concepts for the disciplinary core ideas. Students use *critical reading*, *modeling*, and *conducting investigations*. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Recommended Pacing

See Scope and Sequence

Standards

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.
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
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.
Interdisciplinary Connections	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating an understanding of the subject under investigation.
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research.
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
Integration of Technology	
8.1-	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.

8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will understand that: Scientific methods provide a problem solving framework. Cells are an organism's basic unit of structure and function. Cells carry out life functions through the interactions of systems of organelles and functional molecules. Cellular function is maintained through the regulation of cellular processes in response to internal and external environmental conditions. All organisms must break the high-energy bonds in food molecules during cell respiration to obtain the energy needed for life processes.	How do you form a testable hypothesis that is logically connected to the problem and the design of the experiment? How do the structures of organisms enable life's functions? How do the cells of our body accomplish so many different tasks? How can a single cell perform the same life functions as a complex multicellular organism? Why would a cell placed in distilled water burst? How might some cells be able to prevent this untimely death? How do feedback (positive or negative) mechanisms maintain homeostasis? Why are enzymes essential to life? Why do we need food? Why do astrobiologists look for water on planets and not oxygen when they search for life on other planets? What is the importance of chemical reactions in living organisms and the environment?

Evidence of Learning (Assessments)

Assessments are based on the NHS Curriculum and NJSLS and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assessments are graded using a common scoring rubric or grading criteria.

Assessments Currently in Progress:
Benchmark Assessment
Pre and Post -Assessments
Formative Assessments
Research, Projects and/or Presentations
Lab Reports
Guided Practice
Teacher Observations
Peer Assessments
Summative Assessments

Objectives (SLO)	
Students will know: How various organelles work together to accomplish a task. Every cell started as a stem cell and then became specialized. Different specialized cells function together to perform life functions of an organism. How external conditions affect the internal conditions of an organism. Examine how feedback mechanisms maintain homeostasis within a limited range. 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. How multicellular organisms have a hierarchical structural organization in which one system is made of numerous parts and is itself a component of the next level. The connection between the subcomponents of a biomolecule and its properties. How molecules move across a membrane within the context of membrane structure and function. Why water is important to the survival of living organisms.	Students will be able to: Magnify and focus specimens using the compound light microscope. Design a controlled experiment where the independent and dependent variables are accurately identified. Compare and contrast the structure and function of cells and their components Explain how different specialized cells function together to perform life functions of an organism. Differentiate between positive and negative feedback mechanisms and give examples of each. Explain how homeostasis is maintained at the cellular level through osmosis and diffusion. Explain the connection between the sequence and the subcomponents of a biomolecule and its properties. Explain, using specific examples, how water is important to the survival of living organisms. Diagram the cell membrane and use it to explain how the cell regulates what enters or leaves the cell. Explain how cells can have different structures despite having identical DNA. Predict the effect of different environmental conditions on the size and functions of cells. Diagram the cell membrane and use it to explain how the cell regulates what enters or leaves the cell. Explain how nutrients in food supply the raw materials that are used to build and repair tissue.

Suggested Resources/Technology Tools

Science Websites:
https://www.ibiology.org/
https://basicbiology.net/
http://www.johnkyrk.com/
http://www.bio-alive.com/animations/cell-biology.htm
http://www.biologycorner.com
http://www.pbslearningmedia.org
https://askabiologist.asu.edu/
https://www.khanacademy.org/science/biology
http://www.bozemanscience.com
http://www.nabt.org
http://news.sciencemag.org/category/biology
http://nsf.gov/
https://newsela.com/
http://www.nextgenscience.org
http://nextgenscience.org/overview-topics

Modifications

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

ELL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow ELL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class

- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

21ST CENTURY LIFE AND CAREER STANDARDS

Please select all standards that apply to this unit of study:

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

Suggestions on integrating these standards can be found at: http://www.state.nj.us/education/cccs/2014/career/9.pdf

LINKS TO CAREERS:
https://www.aibs.org/careers/

Unit 2

Heredity: Inheritance and Variation in Traits

Summary and Rationale

This unit is based on the underlying principle that DNA contains the genetic instructions for the development and function of all living things. Students analyze data and develop models to make sense of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next. Students determine why individuals of the same species vary in how they look, function, and behave. Students develop *conceptual models* of the role of DNA in the unity of life on Earth and *use statistical models* to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science are described. Students explain the mechanisms of genetic inheritance and

describe the environmental and genetic causes of gene mutation and the alteration of gene expression.
The crosscutting concepts of *structure and function*, *patterns*, and *cause and effect* are used as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Recommended Pacing

See Scope and Sequence (page 1)

Standards

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.
HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
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.
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.
Interdisciplinary Connections	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
RST.11-12. 9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
WHST.9-12. 1	Write arguments focused on discipline-specific content.
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
MP.2	Reason abstractly and quantitatively.
MP.4	Model with mathematics. (HS-LS1-4)
HSF-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (HS-LS1-4)
HSF-BF.A.1	Write a function that describes a relationship between two quantities. (HS-LS1-4)
Integration of Technology	

8.1-	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will understand that: ● All cells contain genetic information in the form of DNA; the structure of DNA determines the structure of proteins, which carry out the essential functions of life. ● In multicellular organisms individual cells grow and then divide via a process called mitosis. ● Cellular division and differentiation produce and maintain a complex organism; each resulting cell containing identical genetic material in the form of homologous chromosome pairs.. ● Sexual reproduction is the result of independent events in which traits are inherited from parents in a predictable manner based on probability. ● Chromosomes, composed of segments of DNA, control inherited traits. ● Individuals receive half of their genetic information from each parent; in cases in which two or more forms of the gene exist, some may be dominant and others are recessive. ● Alleles for different genes segregate independently of each other. ● Not all traits are inherited in a dominant/recessive pattern	● How does the structure of DNA determines the structure of proteins and what is the function of proteins? ● Why aren't all elephants the same size? ● Why can't two roses be identical? ● How does inheritable genetic variation occur? ● Can a Zoologist predict the distribution of expressed traits in a population?

Evidence of Learning (Assessments)

Assessments are based on the NHS Curriculum and NJSLS and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assessments are graded using a common scoring rubric or grading criteria.

Assessments Currently in Progress:
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Lab Reports

Guided Practice
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Peer Assessments
Summative Assessments

Objectives (SLO)

Students will know:

- 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.
- In multicellular organisms individual cells grow and then divide via a process called mitosis thereby allowing the organism to grow.
- Cellular Division and differentiation produce and maintain a complex organism composed of systems of tissues and organs that work together to meet the needs of the whole organism.
- Each chromosome consists of a single very long DNA molecule in each gene on the chromosome is a particular segment of the DNA.
- The instructions for forming an organism's characteristics are carried in its DNA.
- All cells in an organism have the same genetic content but the genes used or expressed by the cell may be regulated in different ways; not all DNA codes for a protein.
- In sexual reproduction chromosomes can sometimes swap sections during the process of meiosis, thereby creating new genetic combinations and variations.
- How the process of meiosis results in the passage of traits from parent to offspring, and how that results in increased genetic diversity necessary for evolution.
- DNA replication is tightly regulated and remarkably accurate but errors do occur and result in mutations.

Students will be able to:

- Diagram, use paper models or computer simulations to model a DNA molecule and explain how its structure relates to its function in terms of Chargaff's rule.
- Model and demonstrate the process of DNA replication and identify causes of mutations.
- Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms, including why it is important that daughter cells produced are genetic copies of the original cell.
- Diagram mitosis and identify its relationship to the cell cycle.
- Investigate and identify the factors on why cells divide, rather than continue to grow indefinitely.
- Relate cancer to an error in cell cycle regulation.
- Research and investigate the role of DNA and chromosomes in coding instructions for characteristic traits passed from parents to offspring.
- Determine the cause and effect relationship between different forms of cancer with specific environmental factors.
- Create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in the change of a polypeptide produced.
- Explain the importance of genetic material in relation to protein synthesis (transcription & translation).
- Relate the characteristics of a living thing to protein synthesis.
- Explain how humans can alter genetic code through genetic engineering.
- Diagram meiosis and describe how the process results in the passage of traits from parents to offspring and how its results in increase genetic variation.

● Environmental factors can cause mutations in genes. ● Environmental factors can affect the expression of traits in hence affect the probability of occurrence of traits in a population. ● Technological advances that influence the progress of Science and how science has influenced advances in technology.	● Differentiate between the structure and function of chromosomes, genes and alleles. ● Distinguish between chromosomal and point mutations and distinguish between beneficial neutral and harmful mutations. ● Use mathematical principles of probability (punnett squares) to solve selected genetic problems. ● Examine scientific data and predict the distribution of traits in a population. ● Create and analyze a pedigree for multiple generations. ● Compare and contrast Mitosis with Meiosis in terms of diploid and haploid cells. ● Predict the pattern of inheritance of human genetic disorders. ● Conduct research on examples of genetic engineering and expand their claims about the role of DNA and chromosomes. ● Cite evidence from text about how inheritable genetic variations may result from new genetic combinations. ● Use computer models or experimentation to support arguments for the ways inheritable genetic variation occurs.

Suggested Resources/Technology Tools

Science Websites:
https://www.ibiology.org/
https://basicbiology.net/
http://www.johnkyrk.com/
http://www.bio-alive.com/animations/cell-biology.htm
http://www.biologycorner.com
http://www.pbslearningmedia.org
https://askabiologist.asu.edu/
https://www.khanacademy.org/science/biology
http://www.bozemanscience.com
http://www.nabt.org
http://news.sciencemag.org/category/biology
http://nsf.gov/
https://newsela.com/
http://www.nextgenscience.org
http://nextgenscience.org/overview-topics

Modifications

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- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

ELL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
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- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
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- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
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504/IEP

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- Group lab assignments
- Use of scribe
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- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format

- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

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- ❑ Apply appropriate academic and technical skills.
- ❑ Attend to personal health and financial well being.
- ❑ Communicate clearly and effectively and with reason.
- ❑ Consider the environmental social and economic impacts of decisions.
- ❑ Demonstrate creativity and innovation.
- ❑ Employ valid and reliable research strategies.
- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❑ Model integrity, ethical leadership, and effective management.
- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: http://www.state.nj.us/education/cccs/2014/career/9.pdf

LINKS TO CAREERS:
https://www.ashg.org/education/careers.shtml

Unit 3

Biological Evolution: Common Ancestry & Natural Selection

Summary and Rationale

This unit is based on the underlying principle that valid and reliable evidence obtained from a variety of sources lay the foundation for the assumption that scientific 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. The focus then shifts to answering the question, *"How does Natural Selection lead to adaptations of populations?"* Students construct explanations, design solutions, analyze and interpret data and engage in argument from evidence to investigate and make sense of the relationship between the environment and natural selection. Students also develop an understanding of the factors causing natural selection of species over time. They also demonstrate an understanding of how multiple lines of evidence contribute to the strength of scientific theories and

natural selection. Additionally, students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students attempt to answer the question, *"What evidence shows that different species are related?"* by evaluating evidence of conditions that may result in new species and understand the role of genetic variation in natural selection. Students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable trait in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions.

The cross-cutting concepts of *patterns* and *cause and effect* serve as organizing concepts for disciplinary core ideas. Students also use the *science and engineering practices* to demonstrate understanding of *disciplinary core ideas*.

Recommended Pacing

See Scope and Sequence (page 1)

Standards	
HS-LS4-1	**Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.**
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.**
HS-LS4-4	**Construct an explanation based on evidence for how natural selection leads to adaptation of populations.**
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.**
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.**
HS-LS2-8	**Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.**
Interdisciplinary Connections	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
RST-11.12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.
MP.2	Reason abstractly and quantitatively.
Integration of Technology	
8.1-	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will understand that: ● Evolutionary theory is the scientific explanation for the unity and diversity of life. ● Earth's present-day species are descendants from earlier distinctly different species. ● Evolution occurs at the population level, not individual, due to heritable mutations. ● Natural selection leads to adaptation of a population. ● Specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations. ● Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and will continue to do so in the future.	● How can there be so many similarities yet so many different plants, animals and microorganisms? ● How does Natural Selection lead to adaptations of populations? ● Why is it so important to take all of the antibiotics in a prescription even if I feel better? ● How are species affected by changing environmental conditions? ● Why do some species live in groups and others are solitary? ● How do chemical and structural relationships indicate related ancestry? ● What is the Linnaean classification system? ● How do advances in technology change classification? ● How does genetic variation among organisms affect survival and reproduction? ● How does genetic variation among organisms affect survival and reproduction? What is biodiversity, how do humans affect it, and how does it affect humans? ● What evidence shows that different species are related? ● By what criteria do scientists use to classify living organisms? ● How can you identify an unknown organism?
Evidence of Learning (Assessments)	

Assessments are based on the NHS Curriculum and NJSLS and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assessments are graded using a common scoring rubric or grading criteria.

Assessments Currently in Progress:
Benchmark Assessment
Pre and Post -Assessments
Formative Assessments
Research, Projects and/or Presentations
Lab Reports
Guided Practice
Teacher Observations
Peer Assessments
Summative Assessments

Objectives (SLO)

Students will know:

- Common ancestry and biological evolution are supported by multiple lines of empirical evidence, including similarities in DNA sequences, anatomical structures, an order of appearance of structures in embryological development.
- That genetic variation in a population is necessary for natural selection to take place.
- How DNA provides evidence of common descent.
- How fossils support Darwin's theory of evolution.
- Evolution is primarily the consequence of the interaction of four factors - heritable variation, overproduction, competition & reproduction.
- Factors including mutations and sexual reproduction contribute to variation in a population.
- Natural selection can influence frequencies of inheritable traits by providing survival advantages to some individuals.
- How natural selection leads to adaptation of populations.
- That genetic variation in a population is necessary for natural selection to take place.

Students will be able to:

- Connect current learning to pass events to enhance understanding that scientific knowledge is based on natural laws that operate today as they did in the past and will continue to do so in the future.
- Make predictions about the effects of artificial selection on the genetic make/up of an organism.
- Make claims about how natural selection leads to adaptations in populations.
- Use data to provide evidence for how specific biotic and abiotic differences in ecosystem contribute to a change in gene frequency over time, leading to adaptations of population.
- Explain the cause and effect relationships for how changes to the environment affect distribution or disappearance of traits species.
- Develop logical and reasonable arguments based on evidence to evaluate the role of group behavior and individual and species chances to survive and reproduce.
- Group related organisms using a phylogenetic tree or cladogram identify shared characteristics; make inferences about the evolutionary history of the group and identify character did that could extend or improve the phylogenetic tree.
- Explore a variety of hands-on experiments or simulations, such as Kettlewell’s peppered moth

● Classifying is a tool humans use to make sense of the living world around them. ● All organisms on earth can be grouped based upon similarities and differences.	studies to examine how individuals possessing certain forms of inherited traits may have a survival advantage over others in a population. ● Apply concepts of statistics and probability to the relationship between advantageous traits and population size. ● Explain evidence from informational text describing common ancestry and biological evolution; explanation should be supported by analysis reflection and research. ● Examine and give examples of stabilizing, directional and disruptive selection. ● Identify different types of isolation mechanisms that cause speciation. ● Understand taxonomy and categorize animals using a hierarchical system based on similarities and differences.

Suggested Resources/Technology Tools

Science Websites:
https://www.ibiology.org/
https://basicbiology.net/
http://www.johnkyrk.com/
http://www.bio-alive.com/animations/cell-biology.htm
http://www.biologycorner.com
http://www.pbslearningmedia.org
https://askabiologist.asu.edu/
https://www.khanacademy.org/science/biology
http://www.bozemanscience.com
http://www.nabt.org
http://news.sciencemag.org/category/biology
http://nsf.gov/
https://newsela.com/
http://www.nextgenscience.org
http://nextgenscience.org/overview-topics

Modifications

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.

- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

ELL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow ELL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
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- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

21ST CENTURY LIFE AND CAREER STANDARDS

Please select all standards that apply to this unit of study:

- ❑ Act as a responsible and contributing citizen and employee.
- ❑ Apply appropriate academic and technical skills.
- ❑ Attend to personal health and financial well being.
- ❑ Communicate clearly and effectively and with reason.
- ❑ Consider the environmental social and economic impacts of decisions.
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- ❑ Employ valid and reliable research strategies.
- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
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- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.

Suggestions on integrating these standards can be found at: http://www.state.nj.us/education/cccs/2014/career/9.pdf

LINKS TO CAREERS:

https://www.careersinpublichealth.net/careers/genetic-engineer/

Unit 4

Matter & Energy: The Flow through Living Systems & Ecosystems

Summary and Rationale

This unit is based on the underlying principle that sustaining life requires substantial energy and matter inputs. As matter and energy flow through different organizational levels—cells, tissues, organs, organisms, populations, communities, and ecosystems—of living systems, chemical elements are recombined in different ways to form different products. The result of these chemical reactions is that energy is transferred from one system of interacting molecules to another. The focus is on students answering the question, *"How does matter and energy cycle through an ecosystem?"* Students *construct explanations* for the role of energy in the cycling of matter in organisms and ecosystems. They *apply mathematical concepts* to *develop evidence to support explanations* of the interactions of photosynthesis and cellular respiration, and they will *develop models to communicate these explanations*. Students also understand organisms' interactions with each other and their physical environment and how organisms obtain resources.

Students utilize the crosscutting concepts of *matter and energy* and *systems, and system models* to make sense of ecosystem dynamics. Students are expected to use students *construct explanations* for the role of energy in the cycling of matter in organisms and ecosystems. They *apply mathematical concepts* to *develop evidence to support explanations* as they demonstrate their understanding of the disciplinary core ideas.

Recommended Pacing	
See Scope & Sequence (page 1)	
Standards	
HS-LS1-5	**Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.**
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.**
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.**
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.**
HS-LS2-4	**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.**
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.**
Interdisciplinary Connections	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
MP.2	Reason abstractly and quantitatively.
MP.4	Model with mathematics.
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret nits consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Integration of Technology	
8.1-	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.

8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will understand that: ● The main way solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. ● The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. ● All living things perform cellular respiration reactions that break-down biomolecules to convert stored energy into the usable form of energy for all of life which is ATP. These reactions can occur with oxygen (aerobic) and in some organisms without oxygen (anaerobic). ● Aerobic reactions convert more energy than anaerobic reactions, and can lead to muscle fatigue when reactions run in low oxygen situations. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● 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. ● As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. ● Energy drives the cycling of matter within and between systems in aerobic and anaerobic conditions. ● At each link in an ecosystem, matter and energy are conserved. ● Plants or algae form the lowest level of the food web. At each link upward in a food web, only a	● How do organisms obtain and use energy they need to live and grow? ● How do organisms interact with the living and nonliving environment to obtain matter and energy? ● How can the process of photosynthesis and cellular respiration in a cell impact ALL of Earth's systems? ● If energy is conserved, why do people say it is produced or used? ● How do the laws of thermodynamics allow us to predict the flow of energy in organisms and ecosystems? ● How is light energy conserved in ATP during photosynthesis? ● How does the structure of the chloroplast relate to its function in photosynthesis? ● What types of photosynthetic adaptations have evolved in response to environmental conditions? ● How does the structure of the mitochondria relate to its function in cellular respiration? ● How do living things attain usable energy from glucose? ● How is glucose broken down differently in a high concentration of oxygen (aerobically) and a low concentration of oxygen (anaerobically)? ● What causes muscles to fatigue?What interactions exist between photosynthesis and cell respiration?How do matter and energy cycle through ecosystems? ● How do food and fuel provide energy? ● Why is there no such thing as a food chain?

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.	

Evidence of Learning (Assessments)

Assessments are based on the NHS Curriculum and NJSLS and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assessments are graded using a common scoring rubric or grading criteria.

Assessments Currently in Progress:
Benchmark Assessment
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Research, Projects and/or Presentations
Lab Reports
Guided Practice
Teacher Observations
Peer Assessments
Summative Assessments

Objectives (SLO)

Students will know: ● Energy is not created or destroyed, but converted into different forms. ● Recognize that photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth; these processes cycle matter and energy through living systems. ● The factors that affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature).	Students will be able to: ● Draw and label a model of a chloroplast, indicate the key events in the conversion of sunlight energy to chemical energy (photosynthesis). ● Examine the process of cellular respiration including reactants and products, with emphasis on the transformation of energy. ● Diagram the transformation of matter (carbon) from glucose to ATP and carbon dioxide. ● Compare and contrast photosynthesis and cellular respiration reactions.

- How energy transfer occurs during photosynthesis and cellular respiration (i.e., the storage and release of energy in the bonds of chemical compounds).
- Energy transfer from producer to multiple consumer levels is inefficient.
- Use a variety of models, including computer simulations, diagrams, and drawings, to enhance visual, verbal, and/or written understanding of the various ecological cycles (e.g., carbon, nitrogen, water, phosphorus).
- Apply the concept of the cycling of matter directly to ecosystem processes and biogeochemical cycles.
- Plants, algae (including phytoplankton), and other energy fixing microorganisms use sunlight, water, and carbon dioxide to facilitate photosynthesis, which stores energy, forms plant matter, releases oxygen, and maintains plants' activities.

- Explain how nutrients in food supply the raw materials that are used to build and repair tissue.
- Explain the function of enzymes in digestion.
- Model how the digestive system converts food into small molecules that can be used by cells in the body.
- Draw and label a model of a mitochondria, indicate the key events in the conversion of glucose to chemical energy and expand the model to show the location of glycolysis.
- Model photosynthesis and cellular respiration using chemical equations that summarize the interactions between these processes, with emphasis on the transformation of energy.
- Create a pyramid of biomass and food webs to illustrate energy flows through an ecosystem
- Create a model of an ecological system, such as energy pyramids or biogeochemical cycles, to illustrate the energy transfer and the cycling of matter.
- Analyze diagrams of chemical cycles (carbon, nitrogen, water, etc.) to identify the movement of matter within ecosystems.Compare and contrast aerobic and anaerobic respiration.
- Trace the flow of energy through living systems and evaluate the efficiency of energy transfer among organisms in an ecosystem.
- Use mathematical representations to support claims for the cycling of energy and matter.
- Develop a model to illustrate the role of photosynthesis and cellular respiration in the carbon cycle.
- Compare and contrast the differences between autotrophs and heterotrophs
- Describe how feeding relationships can have both direct and indirect effects on community members.
- IIllustrate how interactions among living systems and with their environment result in the movement of matter and energy.

Suggested Resources/Technology Tools

Science Websites:
https://www.ibiology.org/
https://basicbiology.net/
http://www.johnkyrk.com/
http://www.bio-alive.com/animations/cell-biology.htm
http://www.biologycorner.com
http://www.pbslearningmedia.org
https://askabiologist.asu.edu/
https://www.khanacademy.org/science/biology

http://www.bozemanscience.com
http://www.nabt.org
http://news.sciencemag.org/category/biology
http://nsf.gov/
https://newsela.com/
http://www.nextgenscience.org
http://nextgenscience.org/overview-topics

Modifications

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:

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- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

ELL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
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- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

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- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

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- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach

- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format
- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

21ST CENTURY LIFE AND CAREER STANDARDS

Please select all standards that apply to this unit of study:

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

Suggestions on integrating these standards can be found at: http://www.state.nj.us/education/cccs/2014/career/9.pdf

LINKS TO CAREERS:

https://www.learnhowtobecome.org/career-resource-center/careers-with-plants/

Unit 5

Ecosystems: Interdependent Relationships & Dynamics

Summary and Rationale

This unit is based on the underlying principle that biological communities in ecosystems are based on stable interrelationships and interdependence of organisms and their environment. Students formulate answers to the question, *"How and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?"* Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students use mathematical reasoning and models to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter and flow of energy through systems.

The crosscutting concepts of scale, proportion, and quantity and stability and change are called out as organizing concepts for the disciplinary core ideas. Students are expected to use mathematical reasoning and models to demonstrate proficiency with the disciplinary core ideas.

Recommended Pacing

See Scope & Sequence (page 1)

Standards

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

Interdisciplinary Connections	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
MP.2	Reason abstractly and quantitatively.
MP.4	Model with mathematics.
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Integration of Technology	
8.1-	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will understand that: ● Biological communities in ecosystems are based on stable interrelationships and interdependence of organisms. ● Biodiversity is important to the livelihood of animals and humans alike. ● Stability in an ecosystem can be disrupted by natural and human interactions.	● How and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions? ● Is there ever really an ecosystem in balance? ● Should the needs of humans supercede the needs of ecosystems? ● How do humans have an impact on the diversity and stability of ecosystems? ● How do ecosystems respond to negative and positive inputs?

Evidence of Learning (Assessments)

Assessments are based on the NHS Curriculum and NJSLS and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assessments are graded using a common scoring rubric or grading criteria.

Assessments Currently in Progress:
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Guided Practice
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Summative Assessments

Objectives (SLO)

Students will know:	Students will be able to:
● 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. ● That ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. ● Additional limits include factors such as the availability of living and nonliving resources and challenges such as predation, competition, and disease. This fundamental tension affects the abundance (number of individuals) of species in any given 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. ● Under stable conditions, a complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time. ● That humans affect biodiversity by their population numbers, use of land, and their lifestyles, causing damage to habitats for species. ● Biodiversity is the result of evolution, natural processes, and human influence; it is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). ● Sustaining biodiversity aids humanity by preserving landscapes of recreational or inspirational value.	● Investigate organism interactions with each other and their physical environment and how organisms obtain resources. ● View and analyze quantitative data from graphs, charts, simulations, and historical data sets of population changes to determine cause and effect relationships that lead to change in populations over time. ● Predict how fluctuation in population will affect the stability of an ecosystem. ● Explain how an ecosystem is resilient to large-scale changes. ● Compare and contrast animals that live in group settings versus isolation. ● Explain why animals help each other while risking their own survival. ● Describe how ecological succession can change populations and diversity. ● Identify the factors affecting carrying capacity. ● Use mathematics and computational representations to explain factors that affect carrying capacity. ● Explain how the size of a population can continue to grow as its rate of growth decreases. ● Use a table of world population Milestones to identify a trend in population growth. ● Use mathematical and computational representations to explain factors that affect biodiversity. ● Develop and write explanations citing textual evidence, for factors that affect carrying capacity such as famine, disease, competition, predation, and shelter affect the carrying capacity of an ecosystem at different scales. ● Evaluate claims evidence and reasoning about what happens in populations in stable and unstable conditions. ● Predict how changes in an ecosystem affect the population size of predators and prey. ● Predict how the removal of a predator from an ecosystem would affect its prey. ● Evaluate evidence for the role of group behavior in the ability of individuals and species to survive and reproduce. ● Evaluate evidence of how wolves behave in a pack. ● Explain how human activities influence and biodiversity. ● Create a plan to increase biodiversity in an environmentally stressed area. ● Identify the resources provided by biodiversity that are needed for human activity.

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https://www.ibiology.org/
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- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
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LINKS TO CAREERS:
https://www.utsc.utoronto.ca/aacc/career-options-after-conservation-and-biodiversity

Unit 6

Ecosystems: Human Impact on Climate and Biodiversity

Summary and Rationale

This unit is based on the underlying principle that factors such as climate, natural resource availability, and natural disasters have influenced the distribution and development of human society, moreover how earth systems and their relationships are being modified by human activity. Students use computational representations to analyze these relationships and develop an understanding of the interdependence between humans and Earth's systems and how human activities affect natural resource availability. Students will apply their engineering capabilities to reduce human impacts on earth systems, maintain biodiversity and improve social and environmental cost–benefit ratios. In addition, students will use mathematical models to provide support for conceptual understanding of systems and their ability to design, evaluate and refine solutions for reducing the human impacts on Earth systems. The crosscutting concepts of cause and effect, systems and systems models, stability and change, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for the disciplinary core ideas. Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate an understanding of the disciplinary core ideas. Local models also provide support for students conceptual understanding of systems in their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.

Recommended Pacing

See Scope & Sequence (page 1)

Standards

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.**
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.**
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.**

HS-ESS3-4	**Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.**
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.**
Interdisciplinary Connections	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
MP.2	Reason abstractly and quantitatively.
MP.4	Model with mathematics.
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Integration of Technology	
8.1-	All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.
8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
Students will understand that: ● Resource vitality has guided the development of human society. ● Natural hazards and other geologic events (i.e. climate) have significantly altered the sizes of	● How and why do humans interact with their environment and what are the effects of these interactions? ● How do humans depend on Earth's resources? ● How do human activities influence global ecosystem? ● How do natural disasters affect individuals and societies?

human populations and have driven human migration. ● Empirical evidence is required to differentiate between cause and correlation and make claims about how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activities. ● Modern civilization depends on major technological systems. ● Current models predict that, although future regional climate changes will be complex and will vary, average global temperatures will continue to rise. ● The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases are added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. ● 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. ● Human activities can modify the relationships among Earth systems. ● Although the magnitude of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. ● Science investigations use diverse methods and do not always use the same set of procedures to obtain data. ● Science knowledge is based on empirical evidence. ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ● Engineers continuously modify these systems to increase benefits while decreasing costs and risks. ● Feedback (negative or positive) can stabilize or destabilize natural systems. ● When evaluating solutions, it is important to take into account a range of constraints, including costs, safety, reliability, and aesthetics,	● What are the relationships among Earth's systems and how are those relationships being modified due to human activity? ● What is the current rate of global and Regional climate change and what are the associated future impacts to Earth's system? ● How can the impacts of human activities on natural systems be reduced? ● How do the Earth's surface processes and human activities affect each other? ● How do engineers solve problem? ● What is the current rate of global or regional climate change and what are the associated future impacts to Earth's systems. ●

and to consider social, cultural, and environmental impacts. ● New technologies can have deep impacts on society and the environment, including some that are not anticipated.	

Evidence of Learning (Assessments)

Assessments are based on the NHS Curriculum and NJSLS and grade level expectations for science. Authentic assessments are graded using a scoring rubric or grading criteria. Benchmark assessments are graded using a common scoring rubric or grading criteria.

Assessments Currently in Progress:
Benchmark Assessment
Pre and Post -Assessments
Formative Assessments
Research, Projects and/or Presentations
Lab Reports
Guided Practice
Teacher Observations
Peer Assessments
Summative Assessments

Objectives (SLO)

Students will know:	Students will be able to:
● 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. ● 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 aids humanity by preserving landscapes of recreational or inspirational value. ● When evaluating solutions, it is important to take into account a range of constraints	● Construct an explanation based on valid and reliable evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. ● Describe the boundaries of Earth Systems. ● Explain how human activity is influencing biodiversity and describe the inputs and outputs of Earth Systems. ● Design and evaluate solutions for reducing the impact of humans on the environment and biodiversity. ● Evaluate reintroduction of species as a way to maintain biodiversity ● Evaluate a technological solution to a complex real-world problem (human impact on a natural system) 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 ● Evaluate ways to test solutions from mitigating adverse impacts of human activity on biodiversity. ● Use empirical evidence to differentiate between how the availability of natural resources, occurrence of natural

including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. ● Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. ● Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. ● Though 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. ● All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. ● The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.	hazards, and changes in climate have influenced human activity. ● Use a computational representation to illustrate the relationships among Earth systems and how these relationships are being modified due to human activity. ● Analyze and describe the inputs and outputs of Earth systems.

Suggested Resources/Technology Tools

Science Websites:
https://www.ibiology.org/
https://basicbiology.net/
http://www.johnkyrk.com/
http://www.bio-alive.com/animations/cell-biology.htm
http://www.biologycorner.com
http://www.pbslearningmedia.org
https://askabiologist.asu.edu/
https://www.khanacademy.org/science/biology
http://www.bozemanscience.com
http://www.nabt.org
http://news.sciencemag.org/category/biology
http://nsf.gov/
https://newsela.com/
http://www.nextgenscience.org
http://nextgenscience.org/overview-topics

Modifications

Teachers can choose from any of the suggested modifications that follow based upon teaching style, instructional method and needs of individual students.

General Modifications for students struggling to learn:

- Focus on building relationships in the classroom.
- Control the stressors for the student and manage alternate pathways for completion of assignments.
- Provide feedback utilizing a growth mindset and praise what is done correctly based upon effort, attitude and strategy.
- Boost engagement with material by providing opportunities of differentiation, group work and alternative assignments/assessments where appropriate.

ELL

- Provide additional wait time for student responses to questions to allow students the ability to undergo the process of translation between languages, composition of response and attempted response.
- Simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase to allow ELL students to hear the sentence and try to comprehend it.
- Rephrase idioms and teach their meanings as when learning a new language, translations are often very literal. IE "Take a stab at it." Ensure students understand what is meant.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading questions about the main idea and offer help utilizing key words.
- Allow the use of Google Translate where appropriate.
- Utilize bilingual reading texts provided by the STC program.

G/T

Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples include, but are not limited to:

- interdisciplinary and problem-based assignments with planned scope and sequence
- advance, accelerated, or compacted content
- abstract and advanced higher-level thinking
- allowance for individual student interests
- assignments geared to development in areas of affect, creativity, cognition, and research skills
- complex, in-depth assignments
- diverse enrichment that broadens learning
- variety in types of resources
- internships, mentorships and independent study where applicable

504/IEP

Modifications and accommodations must be aligned to stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to science practice include, but are not limited to:

- Note taker or lab assistant
- Group lab assignments
- Use of scribe
- Adjustable tables and lab equipment within reach
- Classrooms, labs and field trips in accessible locations
- Additional time and separate room for test taking
- Additional time for in-class assignments
- Additional time in lab
- Visual and tactile instructional demonstrations
- Computer with voice output, spelling and grammar checker
- Seating in the front of the class
- Tactile drawings and graphs, and three-dimensional models
- Assignments in electronic format

- Large-print handouts, lab signs and equipment labels
- TV monitor connected to microscope to enlarge images
- Computer equipped to enlarge screen characters and images
- Auditory lab warning signals
- Adaptive lab equipment (talking calculators, talking thermometers, light probes, tactile timers)
- Staples on sticks to indicate units of measurement
- Visual warning system for lab emergencies

21ST CENTURY LIFE AND CAREER STANDARDS

Please select all standards that apply to this unit of study:

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

Suggestions on integrating these standards can be found at: http://www.state.nj.us/education/cccs/2014/career/9.pdf

LINKS TO CAREERS:

https://www.utsc.utoronto.ca/aacc/career-options-after-conservation-and-biodiversity