|  |  |
| --- | --- |
| Created on: | July, 2015 |
| Created by:  | Sue Gerlock, Brick; Jennifer Haines, Central; Sarah Steudler, Manchester; Dr. Kathy Chesmel, Plumsted; Lisa Stickel, Toms River; Heather Golla-DeGrandis, Toms River; Amanda Gregorek, Toms River; Tiffany Seeley, Vo-Tech |
| Revised on: |  |
| Revised by: |  |

|  |
| --- |
| **OCEAN COUNTY SCIENCE****BIOLOGY CURRICULUM** |
| **Content Area: Biology** |
| **Course Title:** BIOLOGY | **Grade Level: 9/10** |
|  |
|  | **From Molecules to Organisms:****Structure and Function** |  | **Block 1 MP 1****Block 2 MP 3****Traditional Sept-Nov** |  |
|  |
|  | **Ecosystems:** **Interactions, Energy and Dynamics** |  | **Block 1 MP 1****Block 2 MP 3****Traditional Dec-Feb** |  |
|  |
|  | **Heredity:****Inheritance and Variation of Traits** |  | **Block 1 MP2****Block 2 MP4****Traditional Mar-Apr** |  |
|  |
|  | **Biological Evolution:****Unity and Diversity** |  | **Block 1 MP2****Block 2 MP4****Traditional May-June** |  |
|  |
|  | **\*Nature of Science should be infused through all units (investigations use a variety of methods, science is open to revision etc)** |  |
|  |
|  |

**It is highly suggested to visit the Next Generation Science Standards website where you can download a copy of the Framework for K-12 Science Standards book. This book describes in depth expectations for each standard by grade level. You can access it at** [**http://www.nextgenscience.org/framework-k%E2%80%9312-science-education**](http://www.nextgenscience.org/framework-k%E2%80%9312-science-education)**.**

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM** **From Molecules to Organisms: Structure and Function** |
| **Content Area: Biology** |
| **Unit Title:** From Molecules to Organisms: Structure and Function |
| **Target Course/Grade Level: 9-10** |
| **Unit Summary**  High school students are able to investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. Students demonstrate their understanding through critical reading, using models, and conducting investigations. Students apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration and develop models to communicate these explanations. Students demonstrate the crosscutting concepts of structure and function, matter and energy, and systems and system models in organisms are called out as organizing concepts. **Primary interdisciplinary connections:**

|  |  |
| --- | --- |
| **Common Core State Standards** | **Connection to NGSS** |
| **ELA/Literacy:**RST.11-12.1WHST.9-12.2WHST.9-12.5WHST.9-12.7WHST.11-12.8WHST.9-12.9SL.11-12.5 | (HS-LS1-1) (HS-LS1-6)(HS-LS1-1) (HS-LS1-6)(HS-LS1-3) (HS-LS1-6)(HS-LS1-3)(HS-LS1-3)(HS-LS1-1)(HS-LS1-2) (HS-LS1-7) |

**21st Century Themes:**The unit will integrate the 21st Century Life and Career strand 9.3 Career and Technical Education; Science, Technology, Engineering and Mathematics Career Cluster. Specifically the following strands:9.3.ST.1-69.3.ST-ET.1-69.3.ST-SM.1-4This unit should incorporate: Critical thinking and problem solving, creativity and innovation, collaboration, teamwork and leadership, and cross cultural understanding and interpersonal communication. **Technology connections:**

|  |
| --- |
| **2009 NJCCCS Technology** |
| **CPI#** | **Cumulative Progress Indicator** |
| 8.1.12.A.1 | Construct a spreadsheet, enter data, and use mathematical or logical functions to manipulate data, generate charts and graphs, and interpret the results. |
| 8.2.12.A.1 | Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.  |
| 8.2.12.E.1 | Use the design process to devise a technological product or system that addresses a global issue, and provide documentation through drawings, data, and materials, taking the relevant cultural perspectives into account throughout the design and development process. |

 |
| **Learning Targets** |
| **Next Generation Science Standards**This unit will assimilate the performance expectations from the Next Generation Science Standards. <http://www.nextgenscience.org/sites/ngss/files/HS%20LS%20DCI%20combined%206.13.13.pdf>  |
| **Code** | **Performance Expectations** |
| 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 multi-cellular 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 |
| HS-LS1-7 | Use a model to illustrate the 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 |
| **Unit Essential Questions*** How do the structures of organisms enable life’s functions?
* How do organisms grow and develop?How do organisms obtain and use the matter and energy they need to live and grow?
* How do organisms detect, process, and use information about the environment?
 | **Unit Enduring Understandings***Students will understand that…*[LS1.A: Structure and Function](http://www.nap.edu/openbook.php?record_id=13165&page=143%22)* [Systems of specialized cells within organisms help them perform the essential functions of life.](http://www.nap.edu/openbook.php?record_id=13165&page=143)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=143)
* [Multi cellular](http://www.google.com/url?q=http%3A%2F%2Fwww.nap.edu%2Fopenbook.php%3Frecord_id%3D13165%26page%3D143&sa=D&sntz=1&usg=AFQjCNEBibYVdBNkEbU7bsH2vLvnAtAkvg) [organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.](http://www.nap.edu/openbook.php?record_id=13165&page=143)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=143)
* Living systems, from the organism to the cellular level, demonstrate the complementary nature of structure and function.

[LS1.B: Growth and Development of Organisms](http://www.nap.edu/openbook.php?record_id=13165&page=145)* [In multi cellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. 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.](http://www.nap.edu/openbook.php?record_id=13165&page=145)

[LS1.C: Organization for Matter and Energy Flow in Organisms](http://www.nap.edu/openbook.php?record_id=13165&page=147)* [The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.](http://www.nap.edu/openbook.php?record_id=13165&page=147)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=147)
* [As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.](http://www.nap.edu/openbook.php?record_id=13165&page=147)
* [As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.](http://www.nap.edu/openbook.php?record_id=13165&page=147)
* 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
 |
| **Unit Engineering Practices*** Developing and Using Models
	+ Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
	+ Use a model based on evidence to illustrate the relationships between systems or between components of a system.
* Planning and Carrying Out Investigations
	+ 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 and refine the design accordingly.
* Constructing Explanations and Designing Solutions
	+ Construct an explanation based on valid and reliable evidence obtained from a variety of sources 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.
	+ Construct and revise the explanation based on vdalid and reliable evidence obtained from a variety of sources 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.
 |
| **Unit Objectives***Students will be able to…** Identify the characteristics of living things. (Part of Nature of Science)
* Interpret and construct table and graphs that illustrate scientific findings.
* Understand, evaluate, and practice safe procedures for conducting science investigations.
* Describe how the properties of water make it essential for life (Part of Nature of Science)
* Describe the hierarchical structural organisms (Cells through Ecosystem)
* Describe how homeostasis is essential for maintaining an organisms' internal environment
* Model how and why the function of each major category of organic molecules is essential to life.
* Analyze and explain how cells carry out a variety of chemical transformations that allow the conversion of energy from one from to another.
* Discuss how the integrated functioning of all parts of systems is important for successful interpretation of inputs and responses.
 |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Evidence of Learning** |
| **Formative Assessments** |
| * Observation
* Homework
* Class participation
* Graphic Organizers
* Projects
* Student Response Systems (ex.Clickers)
* Do-Now/Exit Cards
* Laboratories/Lab Reports
* Notebook
* Writing Assignments
* Graphs, Models, and Tables
 |
| **Summative Assessments** |
| * Chapter/Unit Test
* Writing Assignments
* Presentations
* Laboratory Reports/Practical
* Unit Projects
* Quarterlies, Mid-Term, Final Exams
* NJ Competency Test
 |
| **Modifications (ELLs, Special Education, Gifted and Talented)*** Teacher tutoring
* Peer tutoring
* Cooperative learning groups
* Modified assignments (ex. Fewer items per page)
* Native language texts and native language to English dictionary
* Response to Intervention (RTI) ([www.help4teachers.com](http://www.help4teachers.com))
* Follow all IEP modifications/504 plan
* Audio books, Movies, and other digital media in lieu of print versions
* Oral instructions
* Record lessons instead of taking notes
* Outlines of lessons
* Study Guides with answers
* Word processor to type notes
* Frequent breaks
* Extended time
 |
| **Curriculum Development Resources/Instructional Materials/Equipment Needed Teacher Resources:*** Textbook
* Laboratory manuals and equipment
* Science Websites:
	+ <http://www.biologycorner.com>
	+ <http://www.pbslearningmedia.org/>
	+ <https://www.khanacademy.org/science/biology>
	+ [http://www.bozemanscience.com](https://www.bozemanscience.com)
	+ <http://www.nabt.org>
	+ <http://news.sciencemag.org/category/biology>
	+ <http://nsf.gov/>
	+ <https://newsela.com/>
	+ <http://www.nextgenscience.org>

**\*resources will vary for each district** |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Ecosystems: Interactions, Energy and Dynamics** |
| **Content Area: Biology** |
| **Unit Title:** Ecosystems: Interactions, Energy and Dynamics |
| **Target Course/Grade Level: 9-10** |
| **Unit Summary**  High school students can construct explanations for the role of energy in the cycling of matter in organisms and ecosystems and relate the nature of science to how explanations may change in light of new evidence as well as the implications for our understanding of the tentative nature of science. Students understand organisms’ interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. In addition, students demonstrate an ability to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. Students have increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems. Students can generate mathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems.   |
| **Primary interdisciplinary connections:**

|  |  |
| --- | --- |
| **Common Core State Standards** | **Connection to NGSS** |
| **ELA/Literacy:**RST.11-12.1WHST.9-12.2WHST.9-12.5SL11-12.5**Mathematics:**MP.2MP.4HSN-Q.A.1HSN-Q.A.2HSN-Q.A.3 | (HS-LS2-3)(HS-LS2-3)(HS-LS2-3)(HS-LS1-5)(HS-LS2-4)(HS-LS2-4)(HS-LS2-4)(HS-LS2-4)(HS-LS2-4) |

 |
| **21st Century Themes:**The unit will integrate the 21st Century Life and Career strand 9.3 Career and Technical Education; Science, Technology, Engineering and Mathematics Career Cluster. Specifically the following strands:9.3.ST.1-69.3.ST-ET.1-69.3.ST-SM.1-4This unit should incorporate: Critical thinking and problem solving, creativity and innovation, collaboration, teamwork and leadership, and cross cultural understanding and interpersonal communication. **Technology connections:**

|  |
| --- |
| **2009 NJCCCS Technology** |
| CPI# | Cumulative Progress Indicator |
| 8.1.12.A.1 | Construct a spreadsheet, enter data, and use mathematical or logical functions to manipulate data, generate charts and graphs, and interpret the results.  |
| 8.1.12.C.1 | Develop an innovative solution to a complex, local or global problem or issue in collaboration with peers and experts, and present ideas for feedback in an online community.  |
| 8.1.12.E.1 | Develop a systematic plan of investigation with peers and experts from other countries to produce an innovative solution to a state, national, or worldwide problem or issue. |
| 8.2.12.C.1 | Analyze the ethical impact of a product, system, or environment, worldwide, and report findings in a web-based publication that elicits further comment and analysis.  |
| 8.2.12.C.2 | Evaluate ethical considerations regarding the sustainability of resources that are used for the design, creation, and maintenance of a chosen product. |
| 8.2.12.C.3 | Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.  |

 |
| **Learning Targets** |
| **Next Generation Science Standards**This unit will assimilate the performance expectations from the Next Generation Science Standards. <http://www.nextgenscience.org/sites/ngss/files/HS%20LS%20DCI%20combined%206.13.13.pdf>  |
| **Code** | **Performance Expectations** |
| HS-LS2-4 | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem |
| HS-LS1-5 | Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy |
| HS-LS2-5 | Develop a model to illustrate the role of photosynthesis & cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere & biosphere |
| HS-LS2-1 | Use mathematical and/or computational representations to support explanations of factors that affect 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-LS2-7 | Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity |
| HS-LS4-6 | Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity |
| 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 |
| HS-LS2-8 | Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce |
| 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-ETS1 | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. |
| HS-ETS3 | 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. |
| HS-ETS4 | 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. |
| **Unit Essential Questions** * How and why do organisms interact with their environment and what are the effects of these interactions?
* How do organisms interact with the living and nonliving environments to obtain matter and energy?
* How do matter and energy move through an ecosystem?
* What happens to ecosystems when the environment changes?
* How do organisms interact in groups so as to benefit individuals?
 | **Unit Enduring Understandings***Students will understand that…***LS1.C Organization for Matter and Energy Flow in Organisms** * The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen
* As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.

**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
* 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.
* Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and biosphere through chemical, physical, geological and biological processes

**PS3.D: Energy in Chemical Processes** * The main way that solar energy is captured and stored on Earth is through a complex chemical process known as photosynthesis
 |
| **Unit Engineering Units*** Developing and Using Models
	+ Use a model based on evidence to illustrate the relationships between systems or between components of a system.
	+ Develop a model based on evidence to illustrate the relationships between systems or components of a system.
* Using Mathematics and Computational Thinking
	+ Use mathematical representations of phenomena or design solutions to support claims.
* Constructing Explanations and Designing Solutions
	+ 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.
* Engaging in Argument from Evidence
	+ Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
 |
| **Unit Objectives***Students will be able to…** Explain that the process of science attempts to find explanations using evidence for events in the natural world, and to use those explanations to make useful predictions.
* Trace the flow of energy through living systems and evaluate the efficiency of energy transfer among organisms in an ecosystem.
* Describe how the availability of energy affects the ecosystem.
* Identify and describe that interactions that shape communities and the factors that may affect a population
* Describe human activities that affect the biosphere, ways to decrease this disturbance and how ecosystems may or may not recover from a disturbance.
* Investigate and describe the complementary relationship (cycling of matter and flow of energy) between photosynthesis and cellular respiration.
* Analyze and describe how the process of photosynthesis provides a vital connection between the sun and the energy needs of living systems.
 |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Evidence of Learning** |
| **Formative Assessments*** Observation
* Homework
* Class participation
* Graphic Organizers
* Projects
 | * Student Response Systems (ex.Clickers)
* Do-Now/Exit Cards
* Laboratories/Lab Reports
* Notebook
* Writing Assignments
* Graphs, Models, and Tables
 |
| **Summative Assessments*** Chapter/Unit Test
* Writing Assignments
* Presentations
* Laboratory Reports/Practical
* Unit Projects
* Quarterlies, Mid-Term, Final Exams
* NJ Competency Test
 |
| **Modifications (ELLs, Special Education, Gifted and Talented)*** Teacher tutoring
* Peer tutoring & note sharing
* Cooperative learning groups
* Modified assignments (ex. Fewer items per page)
* Grade or asses using a different scale than other classmates
* Mark materials with highlighters
* Audio books, movies, and other digital media in lieu of print versions
* Oral instructions and written instructions
* Record lessons instead of taking notes
* Study Guides prior to evaluations
* Word processor to type notes
* Extended time
 |
| **Curriculum Development Resources/Instructional Materials/Equipment Needed Teacher Resources:*** Textbook
* Laboratory manuals and equipment
* Science Websites:
	+ <http://www.biologycorner.com>
	+ <http://www.pbslearningmedia.org/>
	+ <https://www.khanacademy.org/science/biology>
	+ [http://www.bozemanscience.com](https://www.bozemanscience.com)
	+ <http://www.nabt.org>
	+ <http://news.sciencemag.org/category/biology>
	+ <http://nsf.gov/>
	+ <https://newsela.com/>
	+ <http://www.nextgenscience.org>

**\*resources will vary for each district** |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Heredity:: Inheritance and Variation of Traits** |
| **Content Area: Biology** |
| **Unit Title:** Heredity: Inheritance and Variation of Traits |
| **Target Course/Grade Level: 9-10** |
| **Unit Summary** The performance expectations in the topic Inheritance and Variation of Traits help students in pursuing an answer to the question: “How are the characteristics from one generation related to the previous generation?” High school students demonstrate understanding of the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. Students can determine why individuals of the same species vary in how they look, function, and behave. Students can develop conceptual models for 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 can be described. Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression.  |
| **Primary interdisciplinary connections:**

|  |  |
| --- | --- |
| **Common Core State Standards** | **Connection to NGSS** |
| **ELA/Literacy:**RST.11-12.1RST.11-12.9WHST.9-12.1SL.11-12.5**Mathematics:**MP.2MP.4HSF-IF.C.7HSF-BF.A.1 | (HS-LS3-1) (HS-LS3-2)(HS-LS3-1)(HS-LS3-2)(HS-LS1-4)(HS-LS3-2) (HS-LS3-3)(HS-LS2-4)(HS-LS1-4)(HS-LS1-4) |

 |
| **21st Century Themes:**The unit will integrate the 21st Century Life and Career strand 9.3 Career and Technical Education; Science, Technology, Engineering and Mathematics Career Cluster. Specifically the following strands:9.3.ST.1-69.3.ST-ET.1-69.3.ST-SM.1-4This unit should incorporate: Critical thinking and problem solving, creativity and innovation, collaboration, teamwork and leadership, and cross cultural understanding and interpersonal communication. **Technology connections:**

|  |
| --- |
| **2009 NJCCCS Technology** |
| CPI# | Cumulative Progress Indicator (CPI) |
| 8.1.12.F.1 | Select and use specialized databases for advanced research to solve real world problems.  |
| 8.1.12.F.2 | Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.  |
| 8.2.12.A.1 | Design and create a technology product or system that improves the quality of life and identify trade-offs, risks and benefits.  |
| 8.2.12.C.2  | Evaluate the ethical considerations regarding resources used for the design, creation, maintenance and sustainability of a chosen product. |
| 8.2.12.C.1 | Analyze the ethical impact of a product, system or environment worldwide and report findings in a web-based publication for further comment and analysis. |

 |
| **Learning Targets** |
| **Next Generation Science Standards**This unit will assimilate the performance expectations from the Next Generation Science Standards. <http://www.nextgenscience.org/sites/ngss/files/HS%20LS%20DCI%20combined%206.13.13.pdf>  |
| **Code** | **Performance Expectations** |
| 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 characteristics 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. |
| HS-LS3-3 | Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. |
| **Unit Essential Questions*** How do organisms grow and develop?
* How are characteristics of one generation passed to the next?
* How can individuals of the same species and even siblings have different characteristics?
 | **Unit Enduring Understandings***Students will understand that…***LS1.A Structure and Function*** All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA contain the instructions that code for the formation of proteins.

**LS1.B Growth and Development of Organisms*** In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. 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.

**LS3.A Inheritance of Traits*** 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.

**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.
 |
| **Unit Engineering Practices*** Asking Questions and Defining Problems
	+ Ask questions that arise from examining models or a theory to clarify relationships.
* Developing and Using Models
	+ Use a model based on evidence to illustrate the relationships between systems or between components of a system.
* Analyzing and Interpreting Data
	+ Apply concepts of statistics and probability to scientific and engineering questions and problems, using digital tools when feasible.
* Engaging in Argument from Evidence
	+ Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.
 |
| **Unit Objectives***Students will be able to…** Explain how cell division (mitosis) leads to growth and development of organisms..
* Describe and discuss Mendel's studies and explain how his studies led to our current understanding patterns of inheritance.
* Predict the outcome of genetic crosses using statistics and probability.
	+ Simplify the process of calculating mono-, di-, tri-hybrid crosses using basic probability equations.
	+ Predict the results from various genetic crosses including multiple allele, sex-linked, autosomal dominant, autosomal recessive, and codominant crosses.
* Identify and explain the chromosomal activities that occur during meiosis.
* Compare and contrast mitosis and meiosis.
* Explain how and why an individuals chromosome number needs to remain constant.
* Apply knowledge of genetics to explain mechanisms of inheritance.
* Model the structure and function of a DNA molecule.
* Model the events of DNA replication.
* Model/act out the events of transcription, translation, and polypeptide synthesis.
* Compare and contrast DNA and RNA structure and function.
* Explain the central dogma (path of gene expression) of molecular biology.
* Identify mutations in a DNA sequence and demonstrate the effects of the mutations.
* Describe ways that genetic variations arise (errors in replication, environmental, through meiosis).
* Discuss the role of sexual reproduction in adding variation to organisms.
 |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Evidence of Learning** |
| **Formative Assessments** |
| * Observation
* Homework
* Class participation
* Graphic Organizers
* Projects
* Student Response Systems (ex.Clickers)
* Do-Now/Exit Cards
* Laboratories/Lab Reports
* Notebook
* Writing Assignments
* Graphs, Models, and Tables
 |
| **Summative Assessments*** Chapter/Unit Test
* Writing Assignments
* Presentations
* Laboratory Reports/Practical
* Unit Projects
* Quarterlies, Mid-Term, Final Exams
* NJ Competency Test
 |
| **Modifications (ELLs, Special Education, Gifted and Talented)*** Peer tutoring
* Cooperative learning groups
* Modified assignments (ex. Fewer items per page)
* Differentiated instruction
* Give outlines of lessons in advance
* Have another student share class notes
* Response to Intervention (RTI) ([www.help4teachers.com](http://www.help4teachers.com))
* Follow all IEP modifications/504 plan
* Oral instructions
* Record lessons instead of taking notes
* Study Guides with answers
* Frequent breaks
* Extended time for assignments or assessments
* Use signal or alarm to assist with time management
 |
| **Curriculum Development Resources/Instructional Materials/Equipment Needed Teacher Resources:*** Textbook
* Laboratory manuals and equipment
* Science Websites:
	+ <http://www.biologycorner.com>
	+ <http://www.pbslearningmedia.org/>
	+ <https://www.khanacademy.org/science/biology>
	+ [http://www.bozemanscience.com](https://www.bozemanscience.com)
	+ <http://www.nabt.org>
	+ <http://news.sciencemag.org/category/biology>
	+ <http://nsf.gov/>
	+ <https://newsela.com/>
	+ <http://www.nextgenscience.org>

**\*resources will vary for each district** |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Biological Evolution: Unity and Diversity** |
| **Content Area: Biology** |
| **Unit Title:** Biological Evolution: Unity and Diversity |
| **Target Course/Grade Level: 9-10** |
| **Unit Summary** The performance expectations in the topic Natural Selection and Evolution help students answer the questions: “How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?” High school students can investigate patterns to find the relationship between the environment and natural selection. Students demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution. Students can demonstrate an understanding of the processes that change the distribution of traits in a population over time and describe extensive scientific evidence ranging from the fossil record to genetic relationships among species that support the theory of biological evolution. Students can use models, apply statistics, analyze data, and produce scientific communications about evolution.  |
| **Primary interdisciplinary connections:**

|  |  |
| --- | --- |
| **Common Core State Standards** | **Connection to NGSS** |
| **ELA/Literacy:**RST.11-12.1RST.11-12.8WHST.9-12.2SL.11-12.4**Mathematics:**MP.2MP.4 | (HS-LS4-1) (HS-LS4-2) (HS-LS4-4)(HS-LS4-5)(HS-LS4-1) (HS-LS4-2) (HS-LS4-3) (HS-LS4-4)(HS-LS4-1) (HS-LS4-2)(HS-LS4-1) (HS-LS4-2) (HS-LS4-3) (HS-LS4-5)(HS-LS4-2) |

 |
| **21st Century Themes:**The unit will integrate the 21st Century Life and Career strand 9.3 Career and Technical Education; Science, Technology, Engineering and Mathematics Career Cluster. Specifically the following strands:9.3.ST.1-69.3.ST-ET.1-69.3.ST-SM.1-4This unit should incorporate: Critical thinking and problem solving, creativity and innovation, collaboration, teamwork and leadership, and cross cultural understanding and interpersonal communication. **Technology connections:**

|  |
| --- |
| 2009 NJCCCS Technology |
| CPI # | Cumulative Progress Indicator (CPI) |
| 8.1.12.F.1 | Select and use specialized databases for advanced research to solve real world problems.  |
| 8.1.12.F.2 | Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.  |
| 8.2.12.A.1 | Design and create a technology product or system that improves the quality of life and identify trade-offs, risks and benefits.  |
| 8.2.12.C.2  | Evaluate the ethical considerations regarding resources used for the design, creation, maintenance and sustainability of a chosen product. |

 |
| **Learning Targets** |
| **Next Generation Science Standards**This unit will assimilate the performance expectations from the Next Generation Science Standards. <http://www.nextgenscience.org/sites/ngss/files/HS%20LS%20DCI%20combined%206.13.13.pdf>  |
| **Code** |  **Performance Expectations** |
|  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 processes of evolution primarily results from four factors: (1)the potential for a species to increase 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-LS4-3  | Apply concepts of statistics and probability to support explanations that organism with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. |
| HS-LS4- 4 | Construct an explanation based on evidence for how natural selection leads to adaptations of populations.  |
| 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-LS4-6 | Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity |
| HS-ET1-3 | 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. |
| HS-ET1-4 | 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. |
| **Unit Essential Questions*** How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms?
* What evidence shows that different species are related?
* How does genetic variation among organisms affect survival and reproduction?
* How does the environment influence populations of organisms over multiple
* generations?
* What is biodiversity, how do humans affect it, and how does it affect humans?
 | **Unit Enduring Understandings***Students will understand that…*[LS4.A: Evidence of Common Ancestry and Diversity](http://www.nap.edu/openbook.php?record_id=13165&page=162)* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=162)

[LS4.B: Natural Selection](http://www.nap.edu/openbook.php?record_id=13165&page=163)* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=163)
* [The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.](http://www.nap.edu/openbook.php?record_id=13165&page=163)

[LS4.C: Adaptation](http://www.nap.edu/openbook.php?record_id=13165&page=164)* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=164)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=164)
* [Adaptation also means that the distribution of traits in a population can change when conditions change.](http://www.nap.edu/openbook.php?record_id=13165&page=164)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=164)
* [Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species’ evolution is lost.](http://www.nap.edu/openbook.php?record_id=13165&page=164)

[LS4.D: Biodiversity and Humans](http://www.nap.edu/openbook.php?record_id=13165&page=166)* [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,](http://www.nap.edu/openbook.php?record_id=13165&page=166) [over exploitation](http://www.google.com/url?q=http%3A%2F%2Fwww.nap.edu%2Fopenbook.php%3Frecord_id%3D13165%26page%3D166&sa=D&sntz=1&usg=AFQjCNGCiHzFmPzvs4bhzviAAmQTpWipkQ)[, 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.](http://www.nap.edu/openbook.php?record_id=13165&page=166)

[ETS1.B: Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=206)* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=206)
* [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.](http://www.nap.edu/openbook.php?record_id=13165&page=206)
 |
| **Unit Engineering Practices*** Analyzing and Interpreting 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.
* Using Mathematics & Computational Thinking
	+ Create or revise a simulation of phenomenon, designed device, process or system.
* Constructing Explanations & Designing Solutions
	+ 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.
* Engaging in Argument from Evidence
	+ Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.
* Obtaining, Evaluating and Communicating Information
	+ Communicate scientific information in multiple formats (including orally, graphically, textually and mathematically.)
 |
|
| **Unit Objectives***Students will be able to…** Describe how evolution involves change in the genetic makeup of whole populations over time, not changes in the genes of an individual organism.
* Analyze natural selection simulations and use the data generated to describe how environmentally favored traits are perpetuated over generations resulting in species survival or extinction
* Identify, explain, and demonstrate how technology can be used to determine evolutionary relationships among species.
* Integrate scientific information from a variety of disciplines to provide evidence for the relatedness of species on Earth (geology, comparative anatomy, biochemistry, embryology and taxonomy).
* Recognize that a change in species over time does not follow a set pattern or timeline.
* Explain how the millions of different species on Earth today are related by common ancestry
* Provide a scientific explanation for the fossil record of ancient life forms, and the molecular similarities observed among the diverse species of living organisms.
* Predict possible evolutionary implications for a population due to environmental changes over time (e.g., volcanic eruptions, global climate change, industrial pollution).
* Apply concepts of statistics and probability to support explanations that organism with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
 |

|  |
| --- |
| **OCEAN COUNTY SCIENCE CURRICULUM****Evidence of Learning** |
| **Formative Assessments** |
| * Observation
* Homework
* Class participation
* Graphic Organizers
* Projects
* Student Response Systems (ex.Clickers)
* Do-Now/Exit Cards
* Laboratories/Lab Reports
* Notebook
* Writing Assignments
* Graphs, Models, and Tables
 |
| **Summative Assessments*** Chapter/Unit Test
* Writing Assignments
* Presentations
* Laboratory Reports/Practical
* Unit Projects
* Quarterlies, Mid-Term, Final Exams
* NJ Competency Test
 |
| **Modifications (ELLs, Special Education, Gifted and Talented)*** Teacher tutoring
* Peer tutoring
* Cooperative learning groups
* Modified assignments (ex. Fewer items per page)
* Native language texts and native language to English dictionary
* Response to Intervention (RTI) ([www.help4teachers.com](http://www.help4teachers.com))
* Follow all IEP modifications/504 plan
* Audio books, Movies, and other digital media in lieu of print versions
* Oral instructions
* Record lessons instead of taking notes
* Outlines of lessons
* Study Guides with answers
* Word processor to type notes
* Frequent breaks
* Extended time
 |
| **Curriculum Development Resources/Instructional Materials/Equipment Needed Teacher Resources:*** Textbook
* Laboratory manuals and equipment
* Science Websites:
	+ <http://www.biologycorner.com>
	+ <http://www.pbslearningmedia.org/>

* + <https://www.khanacademy.org/science/biology>

* + [http://www.bozemanscience.com](https://www.bozemanscience.com)

* + <http://www.nabt.org>

* + <http://news.sciencemag.org/category/biology>

* + <http://nsf.gov/>

* + <https://newsela.com/>

* + <http://www.nextgenscience.org>

**\*resources will vary for each district** |

**Suggested Content Sequence**

**All Year**

|  |  |
| --- | --- |
| **Content** | **Possible STEM Activity** |
| Nature of Science | Biomimicry: Natural Designs<https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_bio/cub_bio_lesson05_activity1.xml> Bio in a Box<https://www.nabt.org/websites/institution/File/pdfs/american_biology_teacher/2010/January%202010/Jan2010ABTOn.pdf> |

**MP 1**

|  |  |
| --- | --- |
| **Content** | **Possible STEM Activity** |
| Tools of Science (variables, graphs, binomial nomenclature)Characteristics of LifeWater Properties (how essential for life)MacromoleculesCell Types and quick review of OrganellesCell Membrane (transport, signaling, homeostasis)HierarchyMitosis (purpose)Cell Differentiation | Characteristics of Life:<http://www.stemmom.org/2012/06/living-non-living-vs-dead-lab.html> Active/Passive Transport:<https://www.teachengineering.org/view_activity.php?url=collection/van_/activities/van_membrane3/van_membrane_activity3.xml> Design and specify a biotechnoloy<http://biobuilder.org/biology-by-design/> |

**MP 2**

|  |  |
| --- | --- |
| **Content** | **Possible STEM Activity** |
| Photosynthesis - conversion of light into sugarCellular Respiration -breakdown of sugarNutrient CyclesFood Chains & WebsInterdependent Relationships & Social InteractionsEcosystems Dynamics (succession, invasive species, pollution) | Photosynthesis/Cell Respiration:<http://ciese.org/curriculum/engineering/bio_module_eng_9-13-12.pdf> Ecosystems:<http://www.stemmom.org/2012/02/marine-oil-spill-lab.html> <http://www.tryengineering.org/lessons/engineeradam.pdf><http://www.projectwild.org/educators.htm> |

**MP 3**

|  |  |
| --- | --- |
| **Content** | **Possible STEM Activity** |
| DNA StructureDNA ReplicationProtein Synthesis - gene expressionMutationsMeiosisGeneticsEnvironmental Factors (types of selection) | Genetically Modified Bacteria:<https://www.teachengineering.org/view_activity.php?url=collection/uoh_/activities/uoh_genetic/uoh_genetic_lesson01_activity1.xml>  |

**MP 4**

|  |  |
| --- | --- |
| **Content** | **Possible STEM Activity** |
| DNA to Support Evolution (& other pieces of evidence)Natural Selection (Darwin, adaptations)Speciation & ExtinctionHuman Influences on Biodiversity & Sustainability | Adaptations<http://mrscienceut.net/BirdBeaks.pdf> |

|  |
| --- |
| **Core and Component Ideas in the Life Sciences** |
| *Core Idea LS1; From Molecules to Organisms: Structures and Processes* |
| LS1.A: Structure and FunctionLS1.B: Growth and Development of OrganismsLS1.C: Organization for Matter and Energy Flow in OrganismsLS1.D: Information Processing |
| *Core Idea LS2; Ecosystems: Interactions, Energy and Dynamics* |
| LS2.A: Interdependent Relationships in EcosystemsLS2.B: Cycles of Matter and Energy Transfer in EcosystemsLS2.C: Ecosystem Dynamics, Functioning, and ResilienceLS2.D: Social Interactions and Group Behavior |
| *Core Idea LS3; Heredity: Inheritance and Variation of Traits* |
| LS3.A: Inheritance of TraitsLS3.B: Variation of Traits |
| *Core Idea LS4: Biological Evolution: Unity and Diversity* |
| LS4.A: Evidence of Common Ancestry and DiversityLS4.B: Natural SelectionLS4.C: AdaptationLS4.D: Biodiversity and Humans |