Washington Township School District

The mission of the Washington Township Public Schools *is to provide a safe, positive, and progressive educational environment that provides opportunity for all students to attain the knowledge and skills specified in the NJ Learning Standards at all grade levels, so as to ensure their full participation in an ever-changing world as responsible, self-directed and civic-minded citizens.*

Course Title:	Honors Biology
Grade Level(s):	HS 9th-10th

Duration:	*Full Year:*	X	*Semester:*		*Marking Period:*	
Course Description:	In this course students, will be exposed to the macro and microbiology aspects of our living world. Students will also be exposed to reading, writing and methodology used to study the natural world. During this course the students will study interdependent relationships in ecosystems, matter and energy transformations in ecosystems, human activity in the biosphere, cells and homeostasis, DNA and inheritance patterns, natural selection, and evolution. As part of this course there will be a variety of activities, readings, multimedia resources, and laboratory investigations to fully immerse the students in the study of biological science.					
Grading Procedures:	40% - Tests 30% - Labs 20% - Quizzes 10% - Homework and Classwork Mid Term and Final Examinations 10% of semester grade					
Primary Resources:	Next Generation Science Standards (NGSS) NJDOE HS Biology Model Curriculum NJ Student Learning Standards (NJSLS) *Campbell Biology: Concepts and Connections* Pearson 8th Edition					

Washington Township Principles for Effective Teaching and Learning

- Implementing a standards-based curriculum
- Facilitating a learner-centered environment
- Using academic target language and providing comprehensible instruction
- Adapting and using age-appropriate authentic materials
- Providing performance-based assessment experiences
- Infusing 21st century skills for College and Career Readiness in a global society

Designed by:	Karen Nowicki

Under the Direction of:	Dr. Patricia Hughes

Written: _____August 2017_____

Revised: _____

BOE Approval: _____

Unit Title: Interdependent Relationships in Ecosystems

Unit Description: In this unit of study, 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.

Unit Duration: 4.5 weeks

Desired Results

Standard(s):

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-LS2-6 - Evaluate 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.

Indicators:

LS2.A - Interdependent Relationships in Ecosystems

LS2.C - Ecosystem Dynamics, Functioning, and Resilience

Understandings:

Students will understand that…

- Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support.
- These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, completion, and disease.
- Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (the number of individuals) of species in any given ecosystem.
- Quantitative analysis can be used to compare and determine relationships among interdependent factors that affect the carrying capacity of ecosystems at different scales.
- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions.
- If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the

Essential Questions:

- What is carrying capacity?
- What factors affect carrying capacity?
- What factors affect biodiversity, populations, and interactions?
- How do small and large-scale changes affect ecosystems?

functioning of ecosystems in terms of resources and habitat availability.
- Using the concept of orders of magnitude allows one to understand how a model of factors affecting biodiversity and populations in ecosystems at one scale relates to a model at another scale.

Assessment Evidence

Performance Tasks:

- Evaluate the claims, evidence, and reasoning that support the contention that complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- Construct explanations of how modest biological or physical changes versus extreme changes affect stability and change in ecosystems.
- Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- Use quantitative analysis to compare relationships among interdependent factors and represent their effects on the carrying capacity of ecosystems at different scales.
- Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- Use the concept of orders of magnitude to represent how factors affecting biodiversity and populations in ecosystems at one scale relate to those factors at another scale.

Other Evidence:

Reading and Writing Assignments

Ecological Data Analysis

Food Web Activities

Biome Climatograph

Invasive Species Reading/Writing Assignment

Predator-Prey Interactions Graphing

Symbiotic Relationship Identification

Ecological Succession

Great Australian Rabbit Problem

Reading (sections 34.1-34.5)

Reading (37.1-37.17)

Reading (36.1-36.11)

Laboratory Assignments/Assessments

Hula Hoop Species Richness

Soil Community Survey

Primary Productivity Lab (Vernier)

Mark and Recapture Lab

Virtual Lab: Population Biology

Dandelion Sampling Lab

Quizzes

Quiz – Ecosystems

Quiz – Community Structures

Quiz – Population Ecology

Unit Test(s)

Test – Interdependent Relationships in Ecosystems

Benchmarks: Aquatic Ecosystem Data Analysis and Writing Assignment - https://apcentral.collegeboard.org/pdf/ap-biology-frq-2017.pdf?course=ap-biology (Page 7, Question 4)

Learning Plan

Learning Activities:
Chapter 34 - Ecosystems
Lecture
Reading (sections 34.1-34.5)
Ecological Data Analysis - https://www.biologycorner.com/worksheets/interpreting_data.html
Biome Climatograph – Excel graphing Lab
Primary Productivity lab (Vernier Lab 25)
Hula Hoop Species Richness - https://science.madison.k12.wi.us/files/science/Hula_Hoop_Biodiversity.pdf
Quiz
Chapter 37 – Community Structures
Lecture
Reading (37.1-37.17)
Soil Biological Community Survey
Teacher Selected Food web activity
Ecological succession activities - https://www.biologycorner.com/worksheets/examining_stages_succession.html
Zebra Mussels Invasive species - https://www.biologycorner.com/worksheets/articles/zebra_mussels.html
Predator-prey interactions - https://www.biologycorner.com/worksheets/predator_prey_graphing.html, https://www.biologycorner.com/worksheets/kaibab.html
Symbiotic relationships - https://www.hhmi.org/biointeractive/symbiotic-bioluminescence
Quiz
Chapter 36- Population Ecology
Lecture
Reading (36.1-36.11)
Great Australian Rabbit Problem - https://www.tracy.k12.ca.us/sites/jhaut/Documents/PreAP_Biology/handouts/ch.%2018-19/Great%20Australian%20Rabbit%20Disaster%20Activity.pdf
Mark and Recapture
Population Growth Lab – Lab 9 from Argument-Driven Inquiry in Biology, NSTA
Virtual Lab: Population Biology - https://www.biologycorner.com/worksheets/virtual_lab_population.html
Dandelion sampling - https://www.biologycorner.com/worksheets/dandelion.html
Quiz
Unit Test – Interdependent Relationships in Ecosystems

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources /resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): LS2.A: Interdependent Relationships in Ecosystems: Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.	
4.0	Students will be able to: • Describe how different trophic levels are controlled by different resource pressures and explain how changes to those pressures can affect carrying capacity
3.0	Students will be able to: • Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. • Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
2.0	Students will be able to: • Recognize and recall vocabulary: boundary, carrying capacity, climate, competition, data, ecosystem, interdependent, population, relationship, resource, biodiversity equilibrium, scale • Describe how various factors affect the carrying capacity of ecosystems • Describe how various factors affect the biodiversity and populations of ecosystems
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): LS2.C: Ecosystem Dynamics, Functioning, and Resilience: A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.	
4.0	Students will be able to: • Determine the effects of a trophic cascade • Extrapolate the effects on an ecosystem if trophic levels are removed/drastically reduced or increased
3.0	Students will be able to: • 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.
2.0	Students will be able to: • Recognize and recall vocabulary: biological change, condition, consistent, ecosystem, extreme, interaction, organism, biotic factor, abiotic factor, transition • Describe the effects of transitions and succession in ecosystems
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook

English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: *Common Core Standards Connections*

ELA/Literacy

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.
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Math

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.
HSS-ID.A.1 Represent data with plots on the real number line.
HSS-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Integration of 21st Century Skills

Indicators:

The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:

Using Mathematics and Computational Thinking
Engaging in Argument from Evidence

Cross-Cutting Connections:
Scale, Proportion and Quantity
Stability and Change

Unit Title: Matter and Energy Transformations in Ecosystems

Unit Description: In this unit of study, 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.

Unit Duration: 5.5 weeks

Desired Results

Standard(s):

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

Indicators:

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

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

Understandings:
Students will understand that…

- Energy drives the cycling of matter within and between systems in aerobic and anaerobic conditions.
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.
- 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 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,

Essential Questions:

- How does energy flow in an ecosystem?
- How does matter cycle in an ecosystem?
- What is the difference between aerobic and anaerobic conditions?
- What is photosynthesis?
- What is cellular respiration?
- What are anaerobic respiration and fermentation?
- What is the carbon cycle?
- What are autotrophs/photosynthesizing organisms?

and they are combined and recombined in different ways.

Assessment Evidence

Performance Tasks:

- Construct and revise an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions, 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.
- Support claims for the cycling of matter and flow of energy among organisms in an ecosystem using conceptual thinking and mathematical representations of phenomena.
- Use a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and to show how matter and energy are conserved as matter cycles and energy flows through ecosystems.
- Use a mathematical model to describe the conservation of atoms and molecules as they move through an ecosystem.
- Use proportional reasoning to describe the cycling of matter and flow of energy through an ecosystem.
- Develop a model, based on evidence, to illustrate the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere, showing the relationships among variables in systems and their components in the natural and designed world.

Other Evidence:

Reading and Writing Assignments
Sweet Indigestion Case Study
Mystery of the Toxic Flea Dip Case Study
Sweet Beets: Making Sugar Out of Thin Air Case Study
Reading (Sections 37.14-37.21)
Reading (3.4-3.7)
Readings (6.1-6.4, 6.6, 6.12, 6.13-6.16)
Reading (7.1-7.5, 7.9, 7.10, 7.12-7.14)
Laboratory Assignments/Assessments
Jarrell's iPod Organic Macromolecules Investigation
Virtual Lab: Cellular Respiration (Pearson Lab Bench)
Photosynthesis and Respiration Lab (Vernier)
Carbon Cycle Game
Yeast and Cellular Respiration (Vernier)
Effect of Temperature on Cold Blooded Organisms (Vernier)
Energy in Food Lab (Vernier)

Quizzes

Quiz – Cycles and Energy Pyramids

Quiz – Cellular Respiration

Quiz - Photosynthesis

Unit Test
Matter and Energy Transformation in Ecosystems Unit Test

Benchmarks: Matter and Energy Transformation in Ecosystems Unit Test

Learning Plan

Learning Activities:
Chapter 37 – Cycles and Energy Pyramids
Lecture
Reading (Sections 37.14-37.21)
Carbon Cycle Activities, https://www.windows2universe.org/?page=/earth/climate/carbon_cycle.html, https://www.calacademy.org/educators/lesson-plans/carbon-cycle-role-play or Dice
"Thinking Like a Mountain" by Aldo Leopold Reading and Disscussion
Quiz
Chapter 3 – Carbohydrates
Lecture
Reading (3.4-3.7)
Energy in Food Lab (Vernier Lab 1)
Organic macromolecules
Sweet Indigestion Case Study - http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=375&id=375
Chapter 6 – Cellular Respiration
Lecture
Readings (6.1-6.4, 6.6, 6.12, 6.13-6.16)
Yeast and Respiration (Vernier Lab 12A) or Cellular Respiration (Lab 6 from Argument Driven Inquiry in Biology, NSTA)
Effect of Temperature on Cold-Blooded Organisms (Vernier Lab 23)
Mystery of the Toxic Flea Dip
Tylenol Murders
Virtual Cell Respiration Lab (Pearson Lab Bench)
Quiz
Chapter 7 – Photosynthesis
Lecture
Reading (7.1-7.5, 7.9, 7.10, 7.12-7.14)
Photosynthesis and Respiration lab (Vernier Lab 31A)
Floating Disc Lab – AP Big Idea 2, Investigation 5
Sweet Beets: Making Sugar Out of Thin Air Case Study - http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=798&id=798
Quiz
Unit Test – Matter and Energy Transformation in Ecosystems

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): 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. 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.	
4.0	Students will be able to: • Describe how changes to the inputs of photosynthesis change the outputs • Extrapolate how changes in photosynthesis and cellular respiration change the carbon cycle
3.0	Students will be able to: • Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. • Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
2.0	Students will be able to: • Recall and recognize vocabulary: chemical energy, light energy, matter, organism, photosynthesis, photosynthesizing organism, autotroph, plant, producer, stored energy, transform, atmosphere, biosphere, carbon cycle, cellular respiration, biogeochemical cycle, carbon source, carbon sink • Describe the inputs and outputs of photosynthesis and its importance to organisms • State accurate information about photosynthesis, cellular respiration, and the carbon cycle
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): 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.	
4.0	Students will be able to: • Determine the effects of a trophic cascade on energy flow and matter cycling • Describe the differences between the laws of thermodynamics and conservation of matter
3.0	Students will be able to: • Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions • Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
2.0	Students will be able to: • Recognize and recall vocabulary: aerobic, anaerobic, cycle, energy, matter, environment, flow, respiration, atom, biomass, carbon, conserve, ecosystem, organism, oxygen, tropic level • Describe how matter cycles and energy flows in ecosystems, under aerobic and anaerobic conditions
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations

Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook
English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: *Common Core Standards Connections*

ELA/Literacy

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.

Math

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 21st Century Skills

Indicators:

The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:

Constructing Explanations and Designing Solutions

Using Mathematics and Computational Thinking

Developing and Using Models

Cross-Cutting Connections:

Energy and Matter

Systems and System Models

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

Unit Title: Human Activity and the Biosphere

Unit Description: In this unit of study, students examine factors that have influenced the distribution and development of human society; these factors include climate, natural resource availability, and natural disasters. Students use computational representations to analyze how earth systems and their relationships are being modified by human activity. Students also develop an understanding of how human activities affect natural resources, biodiversity, and of the interdependence between humans and Earth's systems, which affect the availability of natural resources. Students will apply their engineering capabilities to reduce human impacts on earth systems and improve social and environmental cost–benefit ratios. 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 understanding of the disciplinary core ideas.

Unit Duration: 4 weeks

Desired Results

Standard(s):

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-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-ETS1-1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

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.

HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Indicators:

LS2.C: Ecosystem Dynamics, Functioning, and Resilience

LS4.C: Adaptation

LS4.D: Biodiversity and Humans

ESS3.D: Global Climate Change

ETS1.B: Developing Possible Solutions

Understandings:

Students will understand that…

- Resource vitality has guided the development of human society.
- Natural hazards and other geologic events have shaped the course of human history.
- 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.

Essential Questions:

- What is a natural resource?
- What is sustainability?
- How does human activity impact natural resources?
- What is global climate change?
- How does human activity impact biodiversity?
- What steps can be taken to reduce human impact on natural resources?
- What steps can be taken to reduce human impact on biodiversity?
- What steps can be taken to reduce anthropogenic global climate change?

• Changes in climate can affect population or drive mass migration. • 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. • 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. • The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources. • Change and rates of change can be quantified and modeled over very short or very long periods. • Some system changes are irreversible. • New technologies can have deep impacts on society and the environment including some that are not anticipated. • Scientific knowledge is a result of human endeavors imagination and creativity. • 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. • Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). • 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. • Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. • Much of science deals with constructing explanations of how things change and how they remain stable. • Changes in the physical environment, whether naturally occurring or human induced, have	

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.
- Both physical models and computers can be used in various ways to aid the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test 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.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated.

Assessment Evidence

Performance Tasks:

- Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity
- Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
- Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- 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.
- Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Other Evidence:

Reading and Writing Assignments

Pacific Garbage Patch Reading/Writing Assignment

Reading (sections 2.10-2.13)

NOAA CO_2 Mapping Data Analysis Activity

Scratch and Sustainable Pantry Project

Water Cup Models Reading (sections 2.14-2.16)

Reading (Sections 38.1-38.13)

Laboratory Assignments/Assessments

Surface Tension and Properties of Water Lab(s)

Ocean Acidification Inquiry Labs

Acid Rain and pH Lab (Vernier)

Area and Species Richness Lab

Quizzes

Quiz – Water, Acids, and Bases

Quiz – Pollution and Climate Change

Quiz – Conservation Biology

Unit Test

Test – Human Activity in the Biosphere

Benchmarks: Ocean Acidification Culmination Lab

Learning Plan

Learning Activities:
Chapter 2 – Water
Lecture
Reading (sections 2.10-2.13)
Water Cup Activities – 3D Molecular Designs
Properties of Water Activities – Cohesion, Adhesion, Polarity, Surface Tension
Setup Shell Ocean Acidification Lab
Chapter 2 - Acids and Bases
Lecture
Reading (sections 2.14-2.16)
Ocean Acidification Inquiry Lab - https://web.stanford.edu/group/inquiry2insight/cgi-bin/vu-r1a/vu.php
Acid Rain (Vernier Lab 18)
Quiz – Water, Acids and Bases
Pollution and Climate Change
Lecture
NOAA Data Analysis and Climate Change Activity
Pacific Garbage Patch
Quiz
Chapter 38 - Conservation Biology
Lecture
Reading (Sections 38.1-38.13)
Scratch and Sustainable Pantry Project
Current Event Analysis
Habitat Area and Species Richness
Analysis Shell Ocean Acidification Lab and Climate Change
Quiz
Unit Test – Human Activity and the Biosphere

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): LS2.C: Ecosystem Dynamics, Functioning, and Resilience: 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.	
4.0	Students will be able to: • Extrapolate how changes in human activity can affect the environment and biodiversity in the future
3.0	Students will be able to: • Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity
2.0	Students will be able to: • Recognize and recall vocabulary: biodiversity, environment, environmental impact, invasive species, human impact, trophic cascade, trophic level • Describe how technological or social methods have attempted to reduce the impact of human activities
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): LS4.C: Adaptation: 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.	
4.0	Students will be able to: • Describe the de-extinction process and the potential effects of this process
3.0	Students will be able to: • Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
2.0	Students will be able to: • Recognize and recall vocabulary: adverse, biodiversity, endangered species, genetic variation, human activity, human modification of ecosystem, impact, organism, threatened species • Describe ways in which human activity has an adverse impact on biodiversity
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): LS4.D: Biodiversity and Humans: Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.	
4.0	Students will be able to: • Effectively communicate with community members the importance of biodiversity and ways to protect it
3.0	Students will be able to: • Describe the provisioning, regulating, habitat/supporting, and cultural benefits of biodiversity
2.0	Students will be able to: • Recognize and recall vocabulary: biodiversity, environment, environmental impact, invasive species, human impact, trophic cascade, trophic level • Describe how technological or social methods have attempted to reduce the impact of human activities
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): ETS1.B: Developing Possible Solutions: When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.	
4.0	Students will be able to: • Design a solution to a complex real-world problem
3.0	Students will be able to: • Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts
2.0	Students will be able to: • Recognize and recall specific vocabulary: cost, criteria, constraint, impact, prioritize, evaluate, problem, reliability, solution, model, interaction, economical, ecological, tradeoff, manageable, engineering • Describe a possible solution by determining the problem and criteria for solution
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): ESS3.D: Global Climate Change: Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.	
4.0	Students will be able to: • Model changes to a system and extrapolate the effects these changes would have on global climate change
3.0	Students will be able to: • Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
2.0	Students will be able to: • Recognize and recall vocabulary: ocean acidification, atmosphere, biomass, biosphere, carbon dioxide, geosphere, human activity, population • Describe the relationship between the hydrosphere, atmosphere, geosphere and biosphere • Describe how the relationships between Earth's systems are modified due to human activity
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook
English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Special Needs Learners	Follow IEP or 504 modifications and use L1 Differentiated Instruction Activities http://www.nj.gov/education/udl/

Interdisciplinary Connections

Indicators: *Common Core Standards Connections*

ELA/Literacy

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.

WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

Math

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 21st Century Skills

Indicators:

The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:

Constructing Explanations and Designing Solutions
Using Mathematics and Computational Thinking
Analyzing and Interpreting Data
Asking Questions and Defining Problems

Cross-Cutting Connections:

Cause and Effect
Stability and Change
Systems and System Models

Connections to Nature of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

Unit Title: Cells and Homeostasis

Unit Description: In this unit of study, students formulate an answer to the question "How do the structures of organisms enable life's functions?" Students investigate explanations for the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. 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.

Unit Duration: 6.5 weeks

Desired Results

Standard(s):

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-LS1-4 - Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Indicators:

LS1.A - Structure and Function

Understandings:

Students will understand that…

- Systems of specialized cells within organisms help them perform the essential functions of life.
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
- Multicellular 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.
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.
- Feedback mechanisms maintain a living system's internal conditions within certain limits, and they mediate behaviors, allowing the system 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.
- Feedback (negative or positive) can stabilize or destabilize a system.
- Models (e.g., physical, mathematical, and computer models) can be used to simulate systems and interactions, including energy,

Essential Questions:

- What is a cell?
- How do organelles contribute to cellular function?
- What is the role of the membrane?
- What are the different types of human cells and what are their functions?
- What are enzymes?
- How do enzymes impact chemical reactions?
- What are chemical reactions and how are they important to cells?

matter, and information flows, within and between systems at different scales.	

Assessment Evidence	
Performance Tasks: • In the planning of the investigation, decide on the types, amount, and accuracy of the data needed to produce reliable measurements, consider limitations on the precision of the data, and refine the design accordingly. • Develop and use a model based on evidence to illustrate hierarchical organization of interacting systems that provide specific functions within multicellular organism. • Develop and use a model based on evidence to illustrate the interaction of functions at the organism system level. • Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.	**Other Evidence:** *Reading and Writing Assignments* Readings (sections 4.1-4.22) Cell Differentiation Project From Coffee to Carbon Activity Reading (sections 3.8-3.11) Phospholipid Modeling Activity Reading (sections 5.1-5.9) Readings (5.10-5.12, 5.13-5.16) Pre-AP Digestion Enzyme Worksheet *Laboratory Assignments/Assessments* Microscope Lab Introductory Activity Human Cell Comparison Lab Microscope Lab Practical Cell Size and Diffusion Labs Normal and Plasmolyzed Plant Cells Enzyme Virtual Lab Carolina Digestion Lab Lactose Intolerance Cell Signaling Project *Quizzes* Quizzes – Cell Size and Organelle Functions Quiz - Phospholipids Quiz – Cell Membrane and Transport Quiz – Energy in the Cell *Unit Tests* Test – The Cell Mid-Term Test – The Working Cell

Benchmarks: Microscope Lab Practical, Chapter 5 Data Analysis and Written Response questions

Learning Plan

Learning Activities:

Chapter 4 – A Tour of the Cell
Lecture
Readings (sections 4.1-4.22)
Microscope Basics Lab Introductory Activities
Human Cell Differentiation Project
From Coffee to Carbon Activity - http://teach.genetics.utah.edu/content/cells/CoffeetoCarbon.pdf
Human Cell Comparison Lab
Quizzes – Cell Size and Organelle Functions
Microscope Lab Practical
Test
Mid-Term
Chapter 3.8-3.11 – Lipids
Lecture
Reading (sections 3.8-3.11)
Phospholipid Modeling Activity- 3D Molecular Designs
Quiz - Phospholipids
Chapter 5 - The Working Cell
Part 1: Cell Membrane and Transport
Lecture
Reading (sections 5.1-5.9)
Cell Size and Diffusion Labs
Egg Osmosis Lab
Normal and Plasmolyzed Plant Cells Lab
Quiz – Cell Membrane and Transport
Part 2: Chemical Reactions and Enzymes
Lecture
Readings (5.10-5.12, 5.13-5.16)
Enzyme Virtual Lab - https://www.curriculumpathways.com/portal/#info/369
Pre-AP Digestion Enzyme Worksheet
Carolina Digestion Lab
Lactose Intolerance - https://www.hhmi.org/biointeractive/lactose-digestion-infants
Cell Signaling Project
Quiz – Energy in the Cell
Test – The Working Cell

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources and resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): Multicellular 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.	
4.0	Students will be able to: • Determine the result when this structural organization is interrupted by various conditions
3.0	Students will be able to: • Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
2.0	Students will be able to: • Recognize and recall vocabulary: function, hierarchical organization, react, interact, multicellular, organelle, organisms, regulate, tissue • Describe how various systems provide specific functions within multicellular organisms
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): Systems of specialized cells within organisms help them perform the essential functions of life.	
4.0	Students will be able to: • Identify differences and similarities between cells based on their essential functions
3.0	Students will be able to: • 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.
2.0	Students will be able to: • Recognize and recall vocabulary: function, hierarchical organization, react, interact, multicellular, organelle, organisms, regulate, tissue, chemical reaction • Describe the relationship between organelles, cells, tissues, and systems
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook
English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Special Needs Learners	Follow IEP or 504 modifications and use L1 Differentiated Instruction Activities http://www.nj.gov/education/udl/

Interdisciplinary Connections

Indicators: Common Core Standards Connections

ELA/Literacy

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 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.

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.

Math

N/A

Integration of 21st Century Skills

Indicators:

The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:

Constructing Explanations and Designing Solutions
Developing and Using Models
Planning and Carrying Out Investigations

Cross-Cutting Connections:

Stability and Change
Systems and System Models

Unit Title: DNA and Inheritance

Unit Description: In this unit of study, students analyze data 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 expressions. 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.

Unit Duration: 9.5 weeks

Desired Results

Standard(s):

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.

Indicators:

LS3.A - Inheritance of Traits

LS3.B - Variation of Traits

Understandings:

Students will understand that…

- 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.
- 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 the 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, as yet, no known function.
- Empirical evidence is required to differentiate between cause and correlation and to make claims about the role of DNA and chromosomes in coding the instructions for the characteristic traits passed from parents to offspring.

Essential Questions:

- What are nucleic acids and proteins?
- What is the relationship between nucleic acids and proteins?
- What is transcription?
- What is translation?
- What are chromosomes?
- What is mitosis?
- What is meiosis?
- How do cells and organisms reproduce?
- What is genetic variation?
- What is inheritance?
- What are the different inheritance patterns?

- 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 occurrence of traits in a population. Thus, the variation and distribution of traits observed depends on both genetic and environmental factors.
- Cells and organisms reproduce by either asexual or sexual reproduction
- Cell division can be broken down into two types: mitosis and meiosis
- Algebraic thinking is used to examine scientific data and predict the distribution of traits in a population as they relate to the genetic and environmental factors (e.g., linear growth vs. exponential growth).
- Technological advances have influenced the progress of science, and science has influenced advances in technology.
- Science and engineering are influenced by society, and society is influenced by science and engineering.

Assessment Evidence

Performance Tasks:

- Ask questions that arise from examining models or a theory to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parent to offspring.
- Use models to differentiate between mitosis and meiosis
- Use empirical evidence to differentiate between cause and correlation and make claims about the role of DNA and chromosomes in coding the instructions for characteristics passed from parents to offspring.
- Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors.
- Use data to support arguments for the ways inheritable genetic variation occurs.
- Use empirical evidence to differentiate between cause and correlation and make claims about the ways inheritable genetic variation occurs.
- Apply concepts of statistics and probability (including determining function fits to data, slope, intercepts, and correlation coefficient for

Other Evidence:

Reading and Writing Assignments

Readings (sections 3.15-3.17, 3.12-3.14)

DNA and Protein Modeling

Readings (sections 10.1-10.16)

Decoding the Flu Case Study

Readings (sections 8.1-8.23)

Mitosis/Meiosis Modeling

Karyotyping Activity

Protein Synthesis Modeling

Readings (9.1-9.23)

Dragon Genetics

Pop Secret

Laboratory Assignments/Assessments

Virtual Electrophoresis

Comparing Normal and Cancerous Cells Lab

Blood Typing Lab

Genetic Corn Lab

Fruit Fly Lab

linear fits) to explain the variation and distribution of expressed traits in a population. • Use mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. • Use algebraic thinking to examine scientific data on the variation and distribution of traits in a population and predict the effect of a change in probability of traits as it relates to genetic and environmental factors.	*Quizzes* Quiz – Nucleic Acids and Proteins Quizzes – Mitosis and Cancer, Meiosis *Unit Tests* Unit Test – DNA, RNA, and Protein Synthesis Unit Test – Chromosomes, Cell Division, and Cancer

Benchmarks: Fruit Fly Lab, Mitosis and Meiosis test

Learning Plan

Learning Activities:
Chapter 3 – Nucleic Acids and Proteins
Lecture
Readings (sections 3.15-3.17, 3.12-3.14)
DNA and Protein Modeling
Quiz
Chapter 10 – Molecular Biology of the Gene
Lecture
Readings (sections 10.1-10.16)
Protein Synthesis Modeling
Virtual Electrophoresis - http://learn.genetics.utah.edu/content/labs/gel/
Decoding the Flu Case Study - http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=597&id=597
Unit Test – DNA, RNA, and Protein Synthesis
Chapter 8 – The Cellular Basis of Reproduction and Inheritance
Lecture
Readings (sections 8.1-8.23)
Mitosis/Meiosis Modeling - http://www.indiana.edu/~ensiweb/lessons/gen.mm.html
Karyotyping Activity – Magnetic Activiy or http://www.biology.arizona.edu/human_bio/activities/karyotyping/patient_b/y-xx.html
Comparing Normal and Cancerous Cells - http://www.glencoe.com/sites/common_assets/advanced_placement/mader10e/virtual_labs_2K8/pages/CellCycle_and_Cancer.html
Fruit Fly Lab
Quizzes – Mitosis and Cancer, Meiosis
Unit Test – Chromosomes, Cell Division, and Cancer
Chapter 9 – Patterns of Inheritance
Lecture
Readings (9.1-9.23)
Popped Secret - https://www.hhmi.org/biointeractive/popped-secret-film-quiz
Blood Typing Lab - http://www.nobelprize.org/educational/medicine/bloodtypinggame/
Genetic Corn Lab
Dragon Genetics - http://demo.geniverse.concord.org/

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources and resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): LS3.A 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.	
4.0	Students will be able to: • Model and analyze the relationship between DNA, chromosomes, proteins, and organism. • Identify changes to the genetic expression in differentiated cells
3.0	Students will be able to: • Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring
2.0	Students will be able to: • Recall and recognize vocabulary: characteristic, chromosome, homologous pair, code, DNA, function, protein, instruction, offspring, parent, relationships, trait • Describe the function and relationships of DNA, RNA, chromosomes, and proteins
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): LS3.B 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.	
4.0	Students will be able to: • Infer the relationship between mutations and changes on a genotypic and phenotypic level • Identify mutations and the change caused in the organism
3.0	Students will be able to: • 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.
2.0	Students will be able to: • Recognize and recall vocabulary: beneficial, change, chromosomes, function, gene, genetic material, harmful, mutation, neutral, organism, protein, structure, trait, variation, inheritable, meiosis, environmental factor, replication • Describe the ways in which inheritable genetic variation can develop •
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook
English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to

	level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: Common Core Standards Connections

ELA/Literacy

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 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.

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.

Math

N/A

Integration of 21st Century Skills

Indicators:

The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:

Asking Questions and Defining Problems
Constructing Explanations and Designing Solutions
Engaging in Arguments from Evidence

Cross-Cutting Connections:

Cause and Effect
Scale, Proportion and Quantity

Unit Title: Natural Selection

Unit Description: In this unit of study, students constructing explanations and designing solutions, analyzing and interpreting data, and engaging in argument from evidence investigate to 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 and understandings of how multiple lines of evidence contribute to the strength of scientific theories of natural selection. The crosscutting concepts of patterns and cause and effect serve as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Unit Duration: 4 weeks

Desired Results

Standard(s):

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 evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Indicators:

LS4.C - Adaptation

LS4.B - Natural Selection

Understandings:

Students will understand that…

- 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.
- Empirical evidence is required to differentiate between cause and correlation and make claims about how natural selection leads to adaptation of populations.
- Empirical evidence is required to differentiate between cause and correlation and make claims about how 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
- 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,

Essential Questions:

- What is natural selection?
- How does natural selection effect populations?
- What are the two contributing factors to natural selection?
- How does natural selection lead to adaptation?
- What are different life history strategies?
- How do different life history strategies contribute to species survival?

trait variation—that leads to differences in performance among individuals.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.
- Adaptation also means that the distribution of traits in a population can change when conditions change.
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- Changes in the physical environment, whether naturally occurring or human induced, have 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.
- 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.
- Empirical evidence is required to differentiate between cause and correlation and make 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.

Assessment Evidence

Performance Tasks:

- 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 on 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, for how natural selection leads to adaptation of populations.
- Use data to differentiate between cause and correlation and to make claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations.
- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- Analyze shifts in numerical distribution of traits and, using these shifts as evidence, support explanations that organisms with an

Other Evidence:

Reading and Writing Assignments

Readings (sections 13.12-13.18)

Hardy-Weinberg Practice Problems

Pre-AP Hardy-Weinberg Genetic Equilibrium Worksheet

Readings (sections 14.1-14.11)

"It's in the Genes" Turkey Population and Genetics Activity
HHMI Cichlid Speciation Activities

HHMI Pocket Mouse Evolution

Readings (sections 15.7-15.13)

Laboratory Assignments/Assessments

Stick Bug Lab

Paper Airplane "Bird" Natural Selection Lab

Lactose Tolerance Enzyme Lab

Natural Selection with Fruit Flies

Quizzes

Quiz – Hardy-Weinberg

Quiz - Macroevolution Mechanisms

advantageous heritable trait tend to increase in proportion to organisms lacking this trait. • Observe patterns at each of the scales at which a system is studied to provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. • 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. • Determine cause-and-effect relationships for how changes to the environment affect distribution or disappearance of traits in species. • Use empirical evidence to differentiate between cause and correlation and to make 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. • Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.	Quiz - Speciation *Unit Test* Unit Test – Natural Selection

Benchmarks: Natural Selection with Fruit Flies

Learning Plan

Learning Activities:

Chapter 15 – Macroevolution
Lecture
Readings (sections 15.7-15.13)
Stick Bug Lab – Flinn Scientific
Paper Airplane "Bird" Natural Selection Lab
Lactose Tolerance Enzyme Lab
"It's in the Genes" Turkey Population and Genetics Activity
Quiz - Macroevolution Mechanisms
Natural Selection with Fruit Flies
Chapter 13 – Microevolution
Lecture
Readings (sections 13.12-13.18)
Hardy-Weinberg Practice Problems Worksheet
Pre-AP Hardy-Weinberg Genetic Equilibrium Worksheet
Quiz – Hardy-Weinberg
Chapter 14 – Speciation
Lecture
Readings (sections 14.1-14.11)
HHMI Stickleback Speciation Activities - https://www.hhmi.org/bulletin/fall-2012/following-fish-evolution
HHMI Pocket Mouse Evolution - https://www.hhmi.org/biointeractive/pocket-mouse-evolution
Quiz - Speciation
Unit Test – Natural Selection

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources and resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s):LS4.C 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.	
4.0	Students will be able to: • Analyze the relationship between variation of traits, environmental pressure and the survival or organisms
3.0	Students will be able to: • 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
2.0	Students will be able to: • Recognize and recall vocabulary: advantageous, distribution, heritable, increase, organism, proportional, reproductive success, survival, trait • Describe the relationship between advantageous heritable traits and survival of organisms
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Standard(s): LS4.B 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.	
4.0	Students will be able to: • Model how selection pressures can change the genotype frequency of a population
3.0	Students will be able to: • Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
2.0	Students will be able to: • Recognize and recall vocabulary: adaptation, barrier, climate change, ecosystem, evolution, frequency, gene, geographic, natural selection, organism, population, temperature • Describe the relationship between natural selection and adaptation • Describe how environmental pressures result in natural selection
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook
English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include:

	• Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: *Common Core Standards Connections*

ELA/Literacy

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 understanding of the subject under investigation.
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.
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.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.
RST.9-10.8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem
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.

Math

MP.2 Reason abstractly and quantitatively.

Integration of 21st Century Skills

Indicators:

The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.

Science & Engineering Practices:
Analyzing and Interpreting Data
Constructing Explanation and Designing Solutions
Engaging in Argument from Evidence

Cross-Cutting Connections:
Cause and Effect
Patterns

Unit Title: Evolution

Unit Description: In this unit of study, students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions. The crosscutting concepts of patterns and cause and effect support the development of a deeper understanding.

Unit Duration: 2 weeks

Desired Results

Standard(s):

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

Indicators:

LS4.A - Evidence of Common Ancestry and Diversity

Understandings:

Students will understand that…

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.
- Genetic information 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.
- Different patterns in multiple lines of empirical evidence may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of common ancestry and biological evolution.
- 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.
- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to

Essential Questions:

- What is evolution?
- What is descent with modification?
- What is phylogeny?
- What is the tree of life?
- What data are evolutionary relationships based on?
- What is the relationship between natural selection and evolution?

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. • Empirical evidence is required to differentiate between cause and correlation and make claims about the process of evolution.	

Assessment Evidence	
Performance Tasks: • Communicate scientific information in multiple forms that common ancestry and biological evolution are supported by multiple lines of empirical evidence. • Understand the role each line of evidence has relating to common ancestry and biological evolution. • Observe patterns in multiple lines of empirical evidence at different scales and provide evidence for causality in explanations of common ancestry and biological evolution. • 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, 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. • Use empirical evidence to explain the influences of: (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, on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species.	**Other Evidence:** *Reading and Writing Assignments* Galapagos Island Case Study HHMI Great Transitions and the Origin of Tetrapods Reading (sections (13.1-13.7) Reading (sections 15.14-15.19) Bioinformatics and Tree of Life Activity Dichotomous Key Activity HHMI Evolution In Action Data Analysis Activity HHMI Using Data to Explore Lizard Phylogeny Gorilla Genome Journal Article and Questions *Laboratory Assignments/Assessments* Hominid Skull Evolution *Quizzes* Quiz – Evidence of Evolution Quiz – Phylogeny and Evolutionary Relationships *Unit Tests* Unit Test - Evolution

Benchmarks: Bioinformatics and the Tree of Life Activity

Learning Plan

Learning Activities:
Chapter 13 – Evidence of Evolution
Lecture
Reading (sections (13.1-13.7)
Hominid Skull Evolution
Galapagos Island Case Study
Biology of Skin Color - https://www.hhmi.org/order-materials/short-films/biology-skin-color
HHMI Great Transitions and the Origin of Tetrapods - https://www.hhmi.org/biointeractive/great-transitions-origin-tetrapods
Gorilla Genome Journal Article and Questions
Quiz – Evidence of Evolution
Chapter 15 – Phylogeny and the Tree of Life
Lecture
Reading (sections 15.14-15.19)
Bioinformatics and Tree of Life Activity – POGIL for Biology Lab 22
Dichotomous Key Activity
HHMI Evolution In Action Data Analysis Activity - https://www.hhmi.org/biointeractive/evolution-action-data-analysis
HHMI Using DNA to Explore Lizard Phylogeny - https://www.hhmi.org/biointeractive/using-dna-explore-lizard-phylogeny
Quiz – Phylogeny and Evolutionary Relationships
Unit Test - Evolution

Resources:
Textbook and associated etools
Laptops
See Learning Plan for additional links and resources
Vernier LoggerPro™

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): LS4.A Genetic information 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. (HS-LS4-1)	
4.0	Students will be able to: • Construct a phylogenetic tree with a table of characteristics
3.0	Students will be able to: • Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence
2.0	Students will be able to: • Recall and recognize vocabulary: anatomical structure, biological evolution, common ancestry, development, DNA sequence, embryological evidence, origin of life, phylogeny, bioinformatics, shared characteristic, out of Africa hypothesis, similarity • Describe the similarities and differences in various organisms • Describe the process of biological succession
1.0	With help, partial success at level 2.0 content and level 3.0 content:
0.0	Even with help, no success

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instructional Support Explanations & Activities as guided by the textbook
English Language Learners	Use ELL Differentiated Instructional Support Explanations & Activities as guided by the textbook as well as any student specific ESL modification guidelines http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections

Indicators: *Common Core Standards Connections*
ELA/Literacy

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.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

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.
Math
MP.2 Reason abstractly and quantitatively.
MP.4 Model with mathematics

Integration of 21st Century Skills

Indicators:
The standards listed above and the performance tasks and activities that support them are infused with 21st Century Skills. The Level 3 skills listed in each of the Goals & Scales sections involve critical and creative thinking, communication and collaboration. The methods by which students attain these skills require that students practice multi-step problem solving, using technology to research and solve problems, and communicate results with their instructors and peers. The learning activities listed provide a mix of traditional classroom work and interactive, online experiences.
Science & Engineering Practices:
Obtaining, Evaluating and Communicating Information
Constructing Explanations and Designing Solutions
Cross-Cutting Connections:
Cause and Effect
Patterns