Biology Curriculum

2023-2024

Approved by the Academy for Urban Leadership Board of Trustees

April 2023

Founded in 2010 in Perth Amboy, New Jersey, the Academy for Urban Leadership Charter School is one of Middlesex County's comprehensive Public Charter Schools that serves students in seventh through twelfth grades. The school operates under the terms of a charter granted by the New Jersey Department of Education. AUL offers an advanced academic track and AP courses.

AUL has designed its curriculum to focus on Four Academies which include Applied Science, Law/Public & Safety, Business & Technology and Human Development. Students are given an opportunity to explore interests and take courses related to their chosen field, proving students with an opportunity to utilize knowledge in their everyday life.

MISSION STATEMENT OF ACADEMY FOR URBAN LEADERSHIP CHARTER SCHOOL:

To employ an educational design and experience that merges the highest standards of academic excellence while fostering convictions and commitment to social and economic justice.

Goals:

- Provide each student the resources necessary to excel to his/her maximum ability
- Prepare students for success in post-secondary education
- Prepare students with the skills for the workforce
- Prepare students to be leaders in this community
- Prepare students for their civic responsibilities and instill values of good citizenship

UNIT OVERVIEW	
CONTENT AREA: **Biology**	**Unit 0: Science as a Process**
TARGET COURSE/GRADE LEVEL: **Biology 9-12**	**SUGGESTION TIMEFRAME: First two weeks of school**
TOPIC: Science as a Process	**CHAPTERS COVERED: Ongoing throughout each unit**

UNIT SUMMARY/ UNIT RATIONALE:

This unit will serve as an introduction to the course, allow students to begin learning the basic biology and laboratory skills necessary for a successful school year. Students explore the importance of scientific methodology, introducing basic understandings and practices used by scientists. Students will investigate the scientific method, laboratory equipment and techniques, and characteristics of life. Students will focus on NGSS Science and Engineering Practices, particularly "Planning and Carrying Out Investigations". Students are expected to demonstrate grade-appropriate proficiency in the practices of science and engineering by asking questions and defining problems; developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

Math:

HSN-Q.A. l 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. (HSLS2-1), (HS-LS2-2), (HS-LS2-4)

HSN-Q .A.2: Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2- l), (HS-LS2-2), (HS-LS2- 7)

MP.2 Reason abstractly and quantitatively. (HS-LS2-1), (HS-LS2-2), (HS-LS2-4), (HS-LS2-6)

MP.4 Model with mathematics. (HS-LS2-1), (HS-LS2-2), (HS-LS2- 4)

ELA:
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)
WHST.11-12. 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. (HS- LS2- 7), (HS-LS4-6)
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. (HS-ESS3-2), (HS-ESS3-4)
WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1), (HS-LS4-2), (HS-LS4-3), (HS-LS4-4), (HS-LS4-5)

Computer Science and Design Thinking:
8 .1.12.DA.6: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
8.2.12.EC.3: Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.

ESSENTIAL QUESTIONS:

- What are the characteristics of life?
- How do scientists form explanations for events in the natural world?
- How does the scientific definition of theory differ from everyday terminology?
- What makes an organism alive?
- Why homeostasis is important in organism's life?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
[Clarification Statement: Examples of investigations could include heart rate response to exercise,stomata response to moisture and temperature, and root development in response to water levels.] [*Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.*]

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, based on scientific knowledge, student- generated sources of evidence, prioritized criteria, and trade off considerations. By breaking it down into smaller, more manageable problems that can be solved through engineering.

21st Century Skills, 21ST CENTURY LIFE AND CAREER and TECHNOLOGY Standards:

9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions

Content: What information do students need to know?

- Developing and using models
- Planning and carrying out investigations
- Constructing explanations and designing Solutions
- Using mathematics and computational thinking
- Explore phenomena, collect data and analyze data.

Process: What will students be able to do with the information?

- Apply the scientific process for problem solving.
- Develop questions based on observations in order to drive scientific investigation.
- Design a controlled scientific experiment.
- Collect and represent data through a variety of modalities.
- Use mathematics and computational thinking to support scientific conclusions.
- Analyze and interpret data.
- Evaluate the quality of evidence.
- Construct models to explain complex processes and relationships between and within organisms.

	• Engage in argument from evidence to explain natural phenomena. • Construct explanations and design solutions for complex real world environmental problems. • Obtain, evaluate and communicate information to develop technological literacy and an understanding of the role of information technologies in modern scientific endeavors. • Investigate the central themes of biology and the characteristics of living things. • Discuss the importance of proper lab technique and safety precautions.

Modifications:

Special Education	ESL	At-risk	Gifted and Talented
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Visual aides Answer masking Answer eliminator Highlighter Color contrast Extended time	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary Annotation guides Think-pair-share Visual aides	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team work Higher level questioning Critical/Analytical thinking tasl Self-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

- Feedback mechanisms
- Homeostasis
- Scientific method
- Hypothesis versus Null hypothesis

- Control versus Experimental groups
- Independent and dependent variables
- Control versus constant
- Qualitative and quantitative data
- Theory versus Law

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Gummy Bear Lab
- Learn how to write a Lab report
- Students will explain the cause and effect relationships by designing an Experiment using scientific method.
- Plotting independent and dependent data into graphing.

Summative Assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project or Lab related to the Unit
Benchmark Exam

Alternative assessments:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

INSTRUCTIONAL RESOURCES (ELA – INCLUDE VARIOUS LEVELS OF TEXT):

McDougal Littell Biology by Stephen Nowicki
Deepl.com (English to Spanish)
Resources on Edulastic
Khan Academy resource
You tube videos
Teacher created hands on activities.
Student resources on Google classroom.
Lab Manual

TECHNOLOGY RESOURCES:
Individual student Chromebook
Smart Board

UNIT OVERVIEW	
CONTENT AREA: Biology	**UNIT 1: Interdependent Relationships in Ecosystems**
TARGET COURSE/GRADE LEVEL: **Biology 9-12**	**SUGGESTION TIMEFRAME: 5-6 weeks**
TOPIC: Ecology	**CHAPTERS COVERED: 13, 14, 15, 16**

UNIT SUMMARY/ UNIT RATIONALE:
The essential question in this unit is "How do organisms interact with the living and nonliving environment?" Students will have understanding of interactions among organisms and how those interactions influence the population dynamics ofecosystems. Students can generatemathematical comparisons, conduct investigations, use models, and apply scientific reasoning to link evidence to explanations about interactions and changes within ecosystems.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:
Standard Math: Use a mathematical model to describe factors that affect carrying capacity of ecosystems at different scales. Identify important

quantities in factors that affect carrying capacity of ecosystems at different scales and map their relationships using tools. Analyze those relationships mathematically to draw conclusions, reflecting on the results and improving themodel if it has not served its purpose.

Math

• MP.2 Reason abstractly and quantitatively. (HS-LS2-1), (HS-LS2-2), (HS-LS2-4), (HS-LS2-6)
• MP.4 Model with mathematics. (HS-LS2-1), (HS-LS2-2), (HS-LS2- 4)
• HSN-Q.A. l 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. (HSLS2-1), (HS-LS2-2), (HS-LS2-4)
• HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-1), (HS-LS2-2), (HS-LS2-4)
• HSS-IC.A. l Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (HS-LS2-6)
• HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-ESS1-1), (HS-ESS1-2), (HS-ESS1-4)
• HSS-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how those variables are related. (HS-ESS1-6)

Standard 6.1U.S. History :

America in the World. All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions thatreflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

Standard 6.2 World History:

Global Studies: All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

ELA

• 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. (HS-LS2-6), (HS-LS2-8)
• 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. (HS-LS2-l), (HS-LS2-2), (HS-LS2- 3), (HS-LS2-6), (HS-LS2-8)
• 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. (HS-LS2-6), (HS-LS2-8)
• RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS3-5)
• 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. (HS-ESS3-2), (HS-ESS3-4)
• WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)

• 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. (HS-ETS1-1), (HS-ETS1-3)
• 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. (HS-LS4-6)
• 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. (HS-LS4-6)

ESSENTIAL QUESTIONS:

- How can change in one part of an ecosystem affect change in other parts of the ecosystem?
- What factors contribute to changes in populations?
- How have human activities and climate change shaped local and global ecology?
- How does group behavior affect the survival of a species?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-LS2-1: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
[Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [*Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.*]

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.
[Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.][*Assessment Boundary: Assessment is limited to provided data.*]

HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
[Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
[Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

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 (i.e., climate change). [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems. [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

21st Century Skills, 21ST CENTURY LIFE AND CAREER and TECHNOLOGY Standards:

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9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately
9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issuesuch as climate change
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effectsand determine why some solutions (e.g., political. economic, cultural) may work better than others.

Content: What information do students need to know?

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. Thisfundamental tension affects the abundance (number of individuals) of species in any given ecosystem.

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.
- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.

Social Interactions and Group Behavior

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

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.

Process: What will students be able to do with the information?

Ecological Relationships

- Describe the role competition plays in shaping communities.
- Describe the role predation and herbivory play in shaping communities.
- Identify the three types of symbiotic relationships in nature.
- Describe how climate change impacts the environment, leading to population changes and extinctions.
- Describe how ecosystems recover from a disturbance.
- Evaluate the interdependence of food webs. Describe how changes to one population can affect otherspecies in the food web.
- Explain how climate change causes trophic mismatch.
- Predict the impact of a decline in a keystone species.
- Explain how changes in the environment affect animal behavior.
- Explain how social behaviors increase the evolutionary fitness of a species.
- Identify ways that animals communicate.

Population

- List the characteristics used to describe a population.
- Identify factors that affect population growth.
- Model exponential growth.
- Model logistic growth.
- Identify factors that determine carrying capacity.
- Differentiate between density-dependent

Biodiversity and Humans

- 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. 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 recreationalor inspirational value.

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

and density-independent limiting factors.

- Discuss the current and past trends of human population growth.
- Describe the relationship between human population growth and climate change.
- Discuss why population growth rates differ in countries around the world.

Biodiversity

- Define biodiversity.
- Identify threats to biodiversity.
- Explain how climate change can lead to a loss of habitat and biodiversity.
- Identify the factors that influence climate.
- Develop solutions to preserve biodiversity.
- Develop solutions to combat the effects of climate change.
- Explain the concept of ecological footprint.
- Describe human activities that can affect life on Earth.
- Describe the relationship between resource use and sustainable development.
- Discuss the role of ecology in a sustainable future.

Modifications:

Special Education	**ESL**	**At-risk**	**Gifted and Talented**
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Visual aides Answer masking Answer eliminator Highlighter Color contrast	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary Annotation guides Think-pair-share Visual aides	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team work Higher level questioning Critical/Analytical thinking tas Self-directed activities Independent research/inquiry

Extended time				

INSTRUCTION

CONTENT VOCABULARY:

Ecology
Ecosystem
Biome
Abiotic factor/Biotic factor
Carrying capacity
Symbiosis
Commensalism/ Mutualism/Parasitism
Predator and Prey relationship
Population
Community
Competition
Producer/Consumer
Decomposer
Energy pyramid
Exponential Growth/Logistic growth
Food chain/Food Web
Habitat/Niche
Trophic Levels
Limiting factors
Nitrogen fixation
Species
Invasive species
Keystone species
Carbon cycle
Hydrologic cycle

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Given data, students will develop and use models to explain the cause and effect relationships between and within populations by constructing and/or analyzing growth curve graphs. **(HS-LS2-1)**
- Obtain, evaluate, and communicate information regarding the stability and change of an ecosystem as itrelates to a complex set of interactions within an ecosystem. **(HS-LS2-6)**
- Use mathematical and computational data to analyze population growth curves that result from changes inconditions that relate to predation, competition, disease and other finite non-living resources. **(HS-LS2- 1)**
- Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity. **(HS-LS4-6)**
- Play game to create sustainable environment for the population(outtake of SimCity): http://electrocity.co.nz/Game/game.aspx
- Create a poster for your biome Include the following items: Weather & climate Plants, animals and their relationships Ecological concerns or issues.
- Ecological Succession Debate
- Keystone Species Group Project
- Population Growth Short Presentations

Summative Assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project or Lab related to the Unit
Benchmark Exam

Alternative assessments:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques- auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways

to demonstrate their understandings.

- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

INSTRUCTIONAL RESOURCES (ELA – INCLUDE VARIOUS LEVELS OF TEXT):

McDougal Littell Biology by Stephen Nowicki
Deepl.com (English to Spanish)
Resources on Edulastic
Khan Academy resource
You tube videos
Teacher created hands on activities.
Student resources on Google classroom.
Lab Manual

TECHNOLOGY RESOURCES:
Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: Biology	**Unit 2: Matter and Energy in Organisms and Ecosystems**
TARGET COURSE/GRADE LEVEL: **Biology 9-12**	**SUGGESTION TIMEFRAME: 4-5 Weeks**
TOPIC: Matter and Energy	**CHAPTERS COVERED: Chapter 2, 4 and 13**

UNIT SUMMARY/ UNIT RATIONALE:

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 develop models to communicate these explanations. They relate the nature of science to how explanations may change in light of new evidence and the implications for our understanding of the tentative nature of science. Students understand organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. In addition, students utilize the crosscutting concepts of matter and energy and Systems and system models to make sense of ecosystem dynamics.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

Math

• HSN-Q.A. l 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. (HSLS2-l), (HS-LS2-2), (HS-LS2-4)
• HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-l), (HS-LS2-2), (HS-LS2-4) • Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

ELA

• 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. (HS-LSl-3)

• 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. (HS-LSl-3)
• 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. (HS-LS 1- 7)
• 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. (HS-LS2-3)
• 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. (HS-LS2-3)

Computer Science and Design Thinking

• 8.2.12.ETW.3 Identify a complex, global environmental or climate change issue, develop a systematic plan of investigation, and propose an innovative sustainable solution**.**

ESSENTIAL QUESTIONS:

How do organisms obtain and use energy they need to live and grow?
How do matter and energy move through ecosystems?
How do organisms interact with the living and non-living environment to obtain matter and energy?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants andother photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]

HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions oridentification of macromolecules.]

HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process ofcellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]

HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flowof energy in aerobic and anaerobic conditions. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]

HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow ofenergy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning todescribe the cycling of matter and flow of energy.]

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. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]

HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

21st Century Skills, 21ST CENTURY LIFE AND CAREER and TECHNOLOGY Standards:

9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources

9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately
9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issuesuch as climate change
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effectsand determine why some solutions (e.g., political. economic, cultural) may work better than others

Content: What information do students need to know?

Organization for Matter and Energy Flow in Organisms

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxideplus water into sugars plus released oxygen.
- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules(such as proteins or DNA), used for example to form new cells.
- As matter and energy flow through different organizational levels of living systems, chemical elements arerecombined in different ways to form different products.
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transferto the surrounding environment.

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

Process: What will students be able to do with the information?

Ecology (Food Webs/Food Chains, Energy Pyramids and Matter Cycles)

- Explain how biotic and abiotic factors influence an ecosystem.
- Model the methods used to study ecology.
- Describe how consumers obtain energy and nutrients.
- Trace the flow of energy through living systems.
- Calculate the transfer of energy between trophic levels in an ecosystem.
- Describe how climate change affects population changes and extinctions.
- Evaluate the interdependence of food webs. Describe how changes to one population can affect other species in the food web.
- Predict the impact of a decline in a keystone species.
- Identify the three types of ecological

level. Given this inefficiency, there are generally fewer organismsat higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. ● Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. <u>Energy in Chemical Processes</u> ● The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.	pyramids. ● Describe how matter cycles among living and nonliving parts of an ecosystem. ● Describe how water cycles through the biosphere. ● Differentiate between the way matter and energy move through an ecosystem. **Photosynthesis** ● Describe the role of ATP in cellular activity. ● Explain where plants get the energy they need to produce food. ● State the overall equation for photosynthesis. ● Describe what happens during the light-dependent and light-independent reactions of photosynthesis. ● Relate the structure of the chloroplast to its roles in photosynthesis. ● Identify factors that affect the rate at which photosynthesis occurs. ● Explain how climate change affects water availability. ● Evaluate changing levels of carbon dioxide in the atmosphere. ● Describe the inputs and outputs of carbon in the carbon cycle. **Cellular Respiration** ● Define cellular respiration. ● Relate the structure of the mitochondrion to its roles in cell respiration. ● Diagram the interdependent cyclical relationship between photosynthesis

	and cell respiration. ● Model the general steps of cellular respiration. ● Identify how much ATP cellular respiration generates. ● Explain how organisms get energy in the absence of oxygen. ● Describe the inputs and outputs of carbon in the carbon cycle.

Modifications:

Special Education	ESL	At-risk	Gifted and Talented
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Visual aides Answer masking Answer eliminator Highlighter Color contrast Extended time	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary Annotation guides Think-pair-share Visual aides	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team work Higher level questioning Critical/Analytical thinking ta Self-directed activities Independent research/inquir

INSTRUCTION

CONTENT VOCABULARY:

Hydrologic cycle
Carbon cycle
Oxygen cycle
Nitrogen cycle
Energy Pyramid
Biomass Pyramid
Number pyramid
Photosynthesis
Chemosynthesis
Cellular respiration
Aerobic
Anaerobic

ATP
Fermentation
Light-dependent reaction
Light-independent reaction
Exothermic reaction
Endothermic reaction

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbonamong the biosphere, atmosphere, hydrosphere, and geosphere. **(HS-LS2-5)**
- Develop a model to support the claim that matter is conserved and cycled with an ecosystem. **(HS-LS2- 3,HS-LS-4)**
- Using food chains and food webs, construct and revise an explanation based on evidence for the flow ofenergy within ecosystems. **(HS-LS2-3)**
- Design and carry out an experiment to demonstrate the process of cellular respiration. **(HS-LS2-4, HSLS2-5)**

Summative Assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project or Lab related to the Unit
Benchmark Exam

Alternative assessments:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques- auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.

- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

INSTRUCTIONAL RESOURCES (ELA – INCLUDE VARIOUS LEVELS OF TEXT):

McDougal Littell Biology by Stephen Nowicki
Deepl.com (English to Spanish)
Resources on Edulastic
Khan Academy resource
You tube videos
Teacher created hands on activities.
Student resources on Google classroom.
Lab Manual

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: Biology	**UNIT 3: Structure and Function**
TARGET COURSE/GRADE LEVEL: **Biology 9-12**	**SUGGESTION TIMEFRAME: 10- 15 weeks**
TOPIC: Structure and Function	**CHAPTERS COVERED: Chapter 3, 5, 8 and 9**

UNIT SUMMARY/ UNIT RATIONALE:

In this unit, students demonstrate that they can use models to explain how cellular processes maintain homeostasis within cells and therefore within the organism, and defend the claim that living things are organized entities, developed through mitotic division and differentiated into a hierarchy of cells, tissues, organs, etc. Students will conduct investigations and gather evidence to support explanations of cell function and reproduction. The cellular processes can be used as a model for understanding of the hierarchical organization of organisms. Crosscutting concepts of matter and energy, structure and function, and systems and system models provide students with insights to the structures and processes of organisms. It is important to note that the performance expectations described are intended as end-of-instructional unit expectations and additional practices should be used throughout instruction.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

ELA:

RST.9-10.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence. A. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. B. Develop claim(s) and counterclaims using sound reasoning, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form and in a manner that

	anticipates the audience's knowledge level and concerns. C. Use transitions (e.g. words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and betweenclaim(s) and counterclaims. D. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. E.Provide a concluding. (HS-LS1-1).
WHST.9-10.7	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. (HS-LS1-3)

MATH:

MP.2	Reason abstractly and quantitatively. (HS-LS3-2),(HS-LS3-3)
MP.4	Model with mathematics. *(HS-LS1-4)*
HSF-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology formore complicated cases.*(HS-LS1-4)*

ESSENTIAL QUESTIONS:

- How do the structures of organisms enable life's functions?
- What systems and processes keep organisms alive? What happens when those systems break down?
- How does mitosis help to grow and maintain living organisms?
- How does a cell produce a new cell?
- What is the structure of DNA, and how does it function in genetic inheritance?
- How does information flow from the cell nucleus to direct the synthesis of proteins in the cytoplasm?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specializedcells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

HS-LS1-4: Use a model to illustrate the role of cellular division [mitosis] and differentiation in producingand maintaining complex

organisms.
[*Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.*]

HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen and oxygen from sugar molecules may combine with other elements for form amino acids and/or other largecarbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [*Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.*]

21st Century Skills, 21ST CENTURY LIFE AND CAREER and TECHNOLOGY Standards:

9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions

Content: What information do students need to know?

Structure and Properties of Matter

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and placesthose with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

Structure and Function

- Systems of specialized cells within organisms help them perform the

Process: What will students be able to do with the information?

Basic Chemistry

- Determine the structure and properties of atoms and molecules.
- Describe the two major categories of bonding between atoms and molecules.
- Investigate properties of water and how they pertain to life on earth.
- Explain how chemical reactions impact chemical bonds.
- Describe the unique qualities of carbon.

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. ● Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range.Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) whatis going on inside the living system. ● <u>Growth and Development of Organisms</u> ● In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowingthe organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.	● Identify the properties of the four major organic compounds: proteins, lipids, carbohydrates and nucleicacids. ● Explain how climate change can lead to food scarcity. ● Predict the health consequences of malnutrition. ● Explain why enzymes are essential to organisms. <u>Cells</u> ● State the cell theory. ● Use a compound microscope to observe/study cells. ● Describe the limitations of cell size as it relates to its function. ● Describe the structure and function of various organelles within a cell. ● Model the structure of the cell membrane. ● Describe passive transport. ● Describe active transport. ● Explain how unicellular and multicellular organisms maintain homeostasis. ● Compare asexual and sexual reproduction. ● Describe the role of chromosomes in mitosis. ● Explain how the cell cycle is controlled. ● Illustrate the main events of the cell cycle. ● Describe what happens in the 4 phases of mitosis. ● Explain how cancer cells differ from normal cells. ● Describe the process of differentiation. ● Explain why stem cells are important. ● Identify the role of DNA in heredity. ● Identify the chemical components of a DNA molecule. ● Discuss the experiments leading to the identification of DNA and the development of the double-helixmodel. ● Contrast RNA and DNA

	• Summarize the steps in the process of transcription • Identify the genetic code and model how it is read. • Summarize the steps in the process of translation. • Model the role of DNA structure as it determines function in DNA replication and protein synthesis. • Describe the causes and effects of DNA mutations.

Modifications:

Special Education	ESL	At-risk	Gifted and Talented
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Visual aides Answer masking Answer eliminator Highlighter Color contrast Extended time	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary Annotation guides Think-pair-share Visual aides	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team work Higher level questioning Critical/Analytical thinking tas Self-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

Cell organelles
Cell membrane
Hydrophobic
Hydrophilic
Monomer
Polymer
Biomolecule
Macromolecule

Chemical reaction
Enzyme
Activation energy
Lock and key theory
Induced fit theory
Active transport
Passive transport
Solute
Solvent
Hypertonic
Hypotonic
Isotonic
Mitosis
Meiosis
Equal division
Reduction division
Gametes
Fertilization
Zygote
Crossing over
Central dogma
DNA
RNA
Replication
Transcription
Translation
Protein synthesis
Start codon
Stop codon
Polypeptide
Mutation
Gene mutation
Chromosomal mutation
Point mutation
Frameshift mutation

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Develop and use a model of the cell membrane to explain how its structure relates to its function in determining mechanisms of cell transport allowing the cell to remain alive as external conditions change.(**HS-LS1-2, HS-LS1-3)**
- Plan and conduct an investigation of the mechanism and control of the cell cycle in order to explain how itrelates to stability and change of a complex organism. (**HS-LS1-4)**
- Construct an explanation based on evidence on how the structure and function of a protein is dependent on the genetic information in the DNA sequence. **(HS-LS1-1)**

Summative Assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project or Lab related to the Unit
Benchmark Exam

Alternative assessments:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques- auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

INSTRUCTIONAL RESOURCES (ELA – INCLUDE VARIOUS LEVELS OF TEXT):

McDougal Littell Biology by Stephen Nowicki
Deepl.com (English to Spanish)
Resources on Edulastic
Khan Academy resource
You tube videos
Teacher created hands on activities.
Student resources on Google classroom.
Lab Manual

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: Biology	**UNIT 4: Inheritance and Variation of Traits**
TARGET COURSE/GRADE LEVEL: **Biology 9-12**	**SUGGESTION TIMEFRAME: 4 Weeks**
TOPIC: : Inheritance and Variation of Traits	**CHAPTERS COVERED: Chapter 6 and 7**

UNIT SUMMARY/ UNIT RATIONALE:

The performance expectations in this unit help students formulate answers to the questions: "How are characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics?" Students demonstrate understanding of why individuals of the same species vary in how they look, function, and behave. Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression. Students are able to ask questions, make and defend a claim, and use concepts of probability to explain the genetic variation in a population. They then construct an explanation, outlining how DNA produces proteins and understand the role of proteins as essential to the work of the cell and living things. Crosscutting concepts of patterns and cause and effect are called out as organizing concepts for these core ideas. It is important to note that the performance expectations described are intended as end-of-instructional unit expectations and additional practices should be used throughout instruction.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

ELA:

RST.9-10.1.	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4)
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. (HS-LS4-5)
WHST.9-10.2.	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. A. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. B. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. C. Use varied

	transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. D. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. E. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. F. Provide a concluding paragraph or section that supports the argument presented. HS-LS4-1),(HS-LS4- 2),(HS-LS4-3),(HS-LS4-4)
WHST .9-10.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5)
SL.11-12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience. (HS-LS4-1),(HS-LS4-2)
MATH:	
MP.2	Reason abstractly and quantitatively. (HS-LS4-1),(HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5)
MP.4	Model with mathematics. (HS-LS4-2)

ESSENTIAL QUESTIONS:

- What is the molecular basis of an organism's traits?
- What are the mechanisms of inheritance?
- How do traits span generations?
- How are the characteristics from one generation related to the previous generation?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding theinstructions for characteristic traits passed from parents to offspring.
[*Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.*]

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.
[Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressedtraits in a population.
[Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [*Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.*]

21st Century Skills, 21ST CENTURY LIFE AND CAREER and TECHNOLOGY Standards:

9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately

Content: What information do students need to know?

Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA thatcontain the instructions that code for the formation of proteins.

Inheritance of Traits

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is aparticular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

Variation of Traits

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

Process: What will students be able to do with the information?

<u>Meiosis</u>

- Model the process of meiosis, by which cells halve their genetic material in order to maintain chromosomenumbers in sexual reproduction.
- Contrast meiosis and mitosis.
- Contrast the number of chromosomes in body cells and in gametes.
- Explain how variation is introduced in meiosis through the process of crossing over and independentassortment of chromosomes.
- Demonstrate how chromosomal abnormalities result from nondisjunction and rearrangement of chromosomes during meiosis.

source of genetic variation. Environmental factors can also cause mutations in genes, andviable mutations are inherited.

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

Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] havesignificantly altered the sizes of human populations and have driven human migrations.

Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsiblemanagement of natural resources.

<u>Genetics</u>

- Describe Mendel's studies and conclusions about inheritance.
- Illustrate patterns of inheritance using Punnett Squares.
- Differentiate between Mendelian and Non-Mendelian patterns of inheritance.
- Explain the relationship between genes and the environment.

<u>Mutations</u>

- Define mutations and describe the different types of mutations.
- Describe the effects mutations can have on genes.
- Predict the pattern of inheritance of human genetic disorders.
- Explain the importance of maintaining genetic diversity for the health of a population.
- Describe how changes to the climate/environment can be a threat to genetic diversity.
- Evaluate the potential of genetic technologies (such as genetically modified organisms) to combat the effects of climate change.

Modifications:

Special Education	ESL	At-risk	Gifted and Talented
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Visual aides Answer masking Answer eliminator	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary Annotation guides Think-pair-share	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team work Higher level questioning Critical/Analytical thinking Self-directed activities Independent research/inq

Highlighter Color contrast Extended time	Visual aides		

INSTRUCTION

CONTENT VOCABULARY:

Chromosomes
Sex chromosomes
Autosomes
Karyotype
Haploid, and diploid
Heredity
Trait
P generation
F_1 generation
F_2 generation
Dominant and recessive alleles
Independent assortment
Allele
Multiple alleles
Genotype, phenotype
Homozygous, heterozygous
Probability
Codominance & incomplete dominance
Sex linked genes
Gene technology
Recombinant DNA
PCR
Electrophoresis

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Use paper lab, model kits, or box of Styrofoam to Construct a model of DNA or RNA
- Model the process of meiosis to identify sources of genetic variation. **(HS-LS3-2)**

- Analyze and interpret genetic data to determine probability and patterns of inheritance of various genetictraits. **(HS-LS3-1, HS-LS3-3)**
- Construct a solution to combat the threat to genetic diversity caused by climate change and humanactivity. (HS-ESS3-6).

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project or Lab related to the Unit
Benchmark Exam

INSTRUCTIONAL RESOURCES (ELA – INCLUDE VARIOUS LEVELS OF TEXT):

McDougal Littell Biology by Stephen Nowicki
Deepl.com (English to Spanish)
Resources on Edulastic
Khan Academy resource
You tube videos
Teacher created hands on activities.
Student resources on Google classroom.
Lab Manual

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: Biology	**UNIT 5: Natural Selection and Evolution**
TARGET COURSE/GRADE LEVEL: **Biology 9-12**	**SUGGESTION TIMEFRAME: 4-5 Weeks**
TOPIC: Natural Selection and Evolution	**CHAPTERS COVERED: Chapter 10, 11 and 12**

UNIT SUMMARY/ UNIT RATIONALE:

In this unit, students can construct explanations for the processes of natural selection and evolution and communicate how multiple lines of evidence support these explanations. Students can 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 populations as those trends relate to advantageous heritable traits in a specific environment. The crosscutting concepts of cause and effect and systems and system models play an important role in students' understanding of the evolution of life on Earth. It is important to note that the performance expectations described are intended as end-of-instructional unit expectations and additional practices should be used throughout instruction.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

Standard Math: Use a mathematical model to describe factors that affect carrying capacity of ecosystems at different scales. Identify important quantities in factors that affect carrying capacity of ecosystems at different scales and map their relationships using tools. Analyze those relationships mathematically to draw conclusions, reflecting on the results and improving themodel if it has not served its purpose.

Standard 6.1 U.S. History :

America in the World. All students will acquire the knowledge and skills to think analytically about how past and present interactions of people, cultures, and the environment shape the American heritage. Such knowledge and skills enable students to make informed decisions thatreflect fundamental rights and core democratic values as productive citizens in local, national, and global communities.

Standard 6.2 World History:

Global Studies: All students will acquire the knowledge and skills to think analytically and systematically about how past interactions of people, cultures, and the environment affect issues across time and cultures. Such knowledge and skills enable students to make informed decisions as socially and ethically responsible world citizens in the 21st century.

ESSENTIAL QUESTIONS:

- What is natural selection?
- What patterns of biodiversity did Darwin observe while traveling aboard the *Beagle*?
- What are the main lines of scientific evidence that support Darwin's theory of evolution?
- How can populations form new species?
- Why do some organisms go extinct and others survive?
- What factors change the distribution of traits in populations over time?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supportedby multiple lines of empirical evidence.
[Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]

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 forlimited resources, and (4) the proliferation of those organisms that are better able to survive andreproduce in the environment. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has 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. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [*Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.*]

HS-LS4-3: Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tends to increase in proportion to organisms lacking this trait. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [*Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.*]

HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation ofpopulations.
[Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

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 overtime, and (3) the extinction of other species.

[Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

21st Century Skills, 21ST CENTURY LIFE AND CAREER and TECHNOLOGY Standards:

9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving
9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately

Content: What information do students need to know?

Evidence of Common Ancestry and Diversity

- Genetic information, like the fossil record, provides evidence of evolution. DNA sequences vary amongspecies, 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.

Natural Selection

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

Process: What will students be able to do with the information?

Natural Selection

- Discuss Charles Darwin's contribution to science.
- Compare Lamarck's hypothesis of evolution to Darwin's.
- Explain the role of inherited variation in artificial selection.
- Describe the conditions under which natural selection occurs.
- Give examples of selective pressures that can result in changes in the genetic makeup of a population (e.g.peppered moth or Galapagos finches).
- Explain how climate change acts as a selective pressure.
- Compare and contrast acclimatization and adaptation as responses to environmental

Adaptation

- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increasein 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.
- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.
- Adaptation also means that the distribution of traits in a population can change when conditionschange.
- 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.
- 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 thespecies' evolution is lost.

change.

- Explain how natural disasters and human impacts on the environment have affected genetic diversity (Bottleneck effect).
- Explain how the effects of climate change, such as increased migrations, extinctions, and natural disasters,affect genetic drift and gene flow.

<u>Evidence for Evolution</u>

- Explain the principle of common descent.
- Evaluate evidence to explain how natural selection leads to evolution.
- Explain how geologic distribution of species relates to their evolutionary history.
- Explain how fossils document the descent of modern species from ancient ancestors.
- Explain how anatomical structures and embryology provide evidence of evolutionary change.
- Explain how molecular evidence can be used to trace the process of evolution.
- Interpret data to explain how lines of evidence support evolutionary theory.
- Develop and use models, such as phylogenetic trees, to analyze the evolution of organisms based on anatomical traits/DNA/amino acid sequences.

Modifications:

Special Education	ESL	At-risk	Gifted and Talented
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Visual aides Answer masking Answer eliminator Highlighter Color contrast Extended time	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary Annotation guides Think-pair-share Visual aides	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team work Higher level questioning Critical/Analytical thinking task Self-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

Evolution
Natural selection
Artificial selection
DNA, gene
Homologous structures
Analogous structures
Vestigial structures
Variation
Fossilization
Phylogenetic tree
Gene pool
Directional selection,
Stabilizing selection
Artificial selection
Disruptive selection
Genetic drift
Gene flow

Adaptation
Speciation
Adaptive radiation
Comparative anatomy
Comparative embryology
Amino acid sequences.

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Construct an explanation based on evidence that the process of evolution results from adaptation, heritable variation, competition and survival of the fittest. **(HS-LS4-2)**
- Analyze and interpret data from DNA sequence, anatomical structures, embryological similarities and fossilrecords to identify common ancestry as it supports biological evolution. **(HS-LS4-1)**
- Engage in argument from evidence to compare mechanisms of Lamarck's theory of evolution with Darwin'stheory of natural selection. **(HS-LS4-4)**
- Construct an argument predicting how climate change could alter the course of evolution. (HS-ESS3-4)

Summative Assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project or Lab related to the Unit
Benchmark Exam

Alternative assessments:

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and

cultures (e.g. multiple representation and multimodal experiences).

- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.
- Collaborate with after-school programs or clubs to extend learning opportunities.

INSTRUCTIONAL RESOURCES (ELA – INCLUDE VARIOUS LEVELS OF TEXT):

McDougal Littell Biology by Stephen Nowicki
Deepl.com (English to Spanish)
Resources on Edulastic
Khan Academy resource
You tube videos
Teacher created hands on activities.
Student resources on Google classroom.
Lab Manual

TECHNOLOGY RESOURCES:
Individual student Chromebook
Smart Board
Online resources

Prepared by: Nabaneeta Mukherjee

Approved by the AUL Board of Trustees on: _____