Course: Biology **Unit #4: Evolution of Life**	**Year of Implementation: 2019-2020**
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Stage One - Desired Results	
Link(s) to New Jersey Student Learning Standards for this course: **https://www.state.nj.us/education/cccs/2016/science/HS-LS1.pdf** **https://www.state.nj.us/education/cccs/2016/science/HS-LS2.pdf** **https://www.state.nj.us/education/cccs/2016/science/HS-LS3.pdf** **https://www.state.nj.us/education/cccs/2016/science/HS-LS4.pdf**	
Unit Standards: **New Jersey Student Learning Standards:** **HS-LS4-1.** **Communicate scientific information that common ancestry and biological evolution are supported by 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 for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce 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 traits tend 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 of populations.** [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 over time, 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.]
CRP5	**Consider the environmental, social and economic impacts of decisions.** Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP6	**Demonstrate creativity and innovation.** Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP7	**Employ valid and reliable research strategies.** Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

CRP8	**Utilize critical thinking to make sense of problems and persevere in solving them.** Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
9.2.12.C.5	Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures
9.3.12.AG-ANI.5	Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.
9.3.12.AG-FD.2	Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.

Transfer Goal(s): Students will be able to independently use their learning to use predict outcomes between biotic and abiotic factors to predict outcomes and propose solutions on how environmental factors impact play a role in the evolution of a species and the environment.

Enduring Understandings	Essential Questions
Students will understand that. . . EU1 diversity and changing of life forms over many generations is the result of natural selection.	EU1 ● How does natural selection encourage diversity over time? ● What environmental factors cause natural selection to occur? [CM1] ● How have you witnessed evolution in your everyday life? ● How does evolution affect structure and function in organisms over time?

	● How does scientific evidence support evolution by natural selection?
EU2 populations and phenotypic and/or allele frequencies change over time for a variety of reasons by natural selection, mutations, and by chance (Hardy-Weinberg Principle).	EU2 ● How do communities change over time? ● How can populations change over time in the real world? ● Why is natural selection not the only way in which populations change over time?
EU3 environmental changes, abiotic and/or biotic, will lead to changes in biodiversity.	EU3 ● How do environmental changes affect both abiotic and biotic factors of an ecosystem? ● How does the changing of an ecosystem affect biodiversity? ● How can organisms within a species be isolated from one another? ● How do various types of isolation lead to the formation of a new species?
<u>Knowledge</u> Students will know. . . EU1 ● natural selection is based on ideas of variation, inheritance, excess reproduction and advantages of certain traits in certain environments. ● evolutionary evidence supports detail(s) about the sequence in which various lines of descent branched. ● ecosystems have carrying capacities, which limits the numbers of organisms and populations that can be supported within an ecosystem. ● the principles of evolution provide a scientific explanation for the history of the diversity of existing organisms. ● that the process of evolution results from four factors:	<u>Skills</u> Students will be able to. . . EU1 ● construct an explanation based on evidence for the appearance of a novel trait that arose in a given population. HS-LS4-2; HS-LS4-4 ● estimate how closely related species are, based on scientific evidence (e.g., anatomical similarities, similarities of DNA base and/or amino acid sequence). HS-LS4-5 ● provide a scientific explanation for the history of life on Earth using scientific evidence (e.g., fossil record, DNA, protein structures, etc.). HS-LS4-1 ● account for the evolution of a species by citing specific

○ the potential for species to increase in number ○ the heritable genetic variation of individuals in a species is due to mutation and sexual reproduction ○ competition for limited resources ○ the proliferation of those organisms that are better able to survive and reproduce in the environment EU2 ● new traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population. ● chance occurrences within an environment can contribute to the change(s) that occur over time within a population. ● changes in population can be used to predict the probability of species survival within a region. EU3 ● biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). ● there are a variety of ways in which members of the same species can be isolated within a given environment leading to the potential development of a new species over time. ● 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 species' evolution is lost.	evidence of biological mechanisms. HS-LS2-8; HS-LS4-3 EU2 ● model how natural and human-made changes in the environment will affect individual organisms and the dynamics of populations. HS-LS1-7; HS-LS2-1 ● evaluate environmental changes on biodiversity. HS-LS2-6; HS-LS2-1, HS-LS4-5 ● model how changes in population affect the probability of how species thrive based on statistical models. HS-LS4-2. EU3 ● discuss factors that can lead to speciation and/or extinction. HS-LS4-2 ● evaluate natural laws that operate today that have formed our knowledge of past events in our evolutionary history. HS-LS4-1, HS-LS4-4 ● analyze and sequence events that lead to evolutionary change. HS-LS4-1, HS-LS4-3 ● construct an explanation based on evidence for how natural selection leads to adaptations in populations. HS-LS4-4
Stage Two - Assessment	

Other Evidence:

- Tests
- Quizzes
- Evaluation of Data Collected by Experimentation
- Evaluation of Data from Prepared Prompts/Bioethics
- Evaluation of Data and Statistics
- Lab Reports
- Class Discussions
- Teacher-monitored Peer Tutoring

Stage Three - Instruction

Learning Plan: **Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.**

- **PHENOMENON** – Why Were The Finches Affected By The Drought Of 1977? (EU 1) (https://sites.google.com/view/modelbasedinquiry/phenomena-ideas/life-sciences)
  - Discussion on the question, "Why do species survive, adapt or become extinct?" to include: (A)
  - Charles Darwin's theory of Natural Selection: evidence that the process of evolution primarily results from four factors:
    - Potential for a species to increase in number
    - Heritable genetic variation of individuals in a species due to mutation and sexual reproduction
    - Competition for limited resources
    - Proliferation of those organisms that are better able to survive and reproduce in the environment**.**
  - Survival of the fittest (https://www.hhmi.org/biointeractive/origin-species-beak-finch)
  - Common descent (https://www.bbc.com/news/science-environment-42103058)
  - Evidence of evolution (https://www.sciencedaily.com/releases/2015/02/150211141238.htm)
  - Lab activity: Evolutionary comparison of how organisms, from simple to complex, have adapted to perform various life processes in their respective environments (M)

- Comparing Evolutionary Changes in Animals Lab (https://www.dentonisd.org/cms/lib/TX21000245/Centricity/Domain/667/evidence%20of%20evolution%20answers%20.pdf)
- Lab activity: Use virtual simulation to change the environment of a species to determine how it can survive. Natural Selection "Bug" Simulation (http://sciencenetlinks.com/interactives/evolution.html) (M)
- Lab activity: Use different tools and objects to analyze how features determine fitness. The Beak Lab (http://www.epcc.edu/Biology/Documents/Natural%20Selection%202015/Natural_Selection_Bird_Beak.pdf) (M)
- Lab activity: Use features of different species to design a cladogram to show evolutionary path of species. Evolution of Flight (http://www.ucmp.berkeley.edu/education/explorations/reslab/flight/guide/index.html) (M)

- **PHENOMENON**: What causes The Lampsilis Mussel to Have a Lifelike Lure? (EU 2,3) (https://sites.google.com/view/modelbasedinquiry/phenomena-ideas/life-sciences)
  - Discussion on the topics of: (A)
    - Genetic Drift
    - Mutation in terms of positive adaptations for survival: Antibiotic resistance: overuse of antibiotics and the evolution of bacteria (i.e. MRSA)
  - Environmental pressures: Human versus Natural: (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.
  - Lab activity: Use a virtual simulation to demonstrate species change of the peppered moth over time. The Peppered Moth (www.peppermoths.weebly.com) (M)
  - Lab activity: Students are given a fictitious environment and have to create a creature that can survive in it. (T)