Course: Biology Unit #5: Human Impact on Ecological Systems	Year of Implementation: 2019-2020

Curriculum Team Members: Kelly Balkus (kbalkus@lrhsd.org), Leanne DeBlieu (ldeblieu@lrhsd.org), Amanda Fitchett (afitchett@lrhsd.org), Mary Pallis (mpallis@lrhsd.org), Darcy Roth (droth@lrhsd.org)

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-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 of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]
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-LS2-8.	**Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.**[Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]
HS-LS4-6.	**Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.***[Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

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.]
HS-ESS3-1.	**Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.** [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]
HS-ESS3-3.	**Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.** [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]
HS-ESS3-4.	**Evaluate or refine a technological solution that reduces impacts of human activities on 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).]
	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for

HS-ETS1-1.	**solutions that account for societal needs and wants.**
HS-ETS1-2.	**Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**
HS-ETS1-3.	**Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**
HS-ETS1-4.	**Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.**
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

9.3.12.AG-NR.1 Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.

9.3.12.AG-NR.2 Analyze the interrelationships between natural resources and humans.

9.3.12.AG-NR.3 Develop plans to ensure sustainable production and processing of natural resources.

Transfer Goal(s): Students will be able to independently use their learning to examine how humans impact ecosystems and societies by analyzing the interactions between biotic and abiotic factors.

Enduring Understandings Students will understand that. . .	Essential Questions
EU1 the survival and diversity of organisms is affected by environmental changes, which can be altered by human activity.	EU1 ● How has human activity changed communities over time? ● What are the most significant threats to biodiversity? ● What are some solutions to reduce human activity and impact on ecosystems? ● Who are the stakeholders within an ecosystem? ● How can stakeholders within an ecosystem manage natural resources, sustain human populations, and maintain biodiversity?
EU2 biodiversity is important to the health of the biosphere.	EU2 ● Why does biodiversity need to be preserved and how do we do we go about preserving it? ● How can the decline, elimination, and/or extinction of a species affect an entire ecosystem?

Knowledge Students will know. . . EU1 ● humans depend on the living world for the resources and other benefits provided by biodiversity. ● 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. ● human activity has adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. ● Fluctuations in conditions or the size of a population can challenge the functioning of ecosystems in terms of resources and habitat availability. EU2 ● human activity has adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. ● sustaining biodiversity is essential to supporting and enhancing life on Earth and also aids humanity by preserving landscapes of recreational or inspirational	Skills Students will be able to. . . EU1 ● design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity HS-LS2-7 ● use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales HS-LS2-2 ● Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. HS-LS2-6 ● 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 ● analyze a major global challenge (i.e. deforestation, overhunting, increased human population etc.) to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-1 ● design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-2 EU2 ● use technology to create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity HS-LS4-6, HS-ESS3-4 ● defend the importance of preserving biodiversity HSESS3-1 ● use a computer simulation to illustrate the relationships

value. ● a major key to maintaining not only individual species but also a robust diversity of species is preserving the proper habitat for those species.	among management of natural resources, the sustainability of human populations, and biodiversity in a complex real-world problem. HS-ESS3-3, HS-ETS1-4 ● evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-3
Stage Two - Assessment	
Other Evidence: ● Food web demonstrating feeding relationships of a given biodiversity hotspot ● Graphical representation of deforestation data world-wide over time ● Debate participation on saving endangered species ● Powerpoint and oral presentation of proposed biodiversity conservation plan ● Self assessment on final plan	
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** – Polar bears are Starving (A,M) https://news.nationalgeographic.com/2018/02/polar-bears-starve-melting-	

sea-ice-global-warming-study-beaufort-sea-environment/

- ENVIRONMENT
  - Watch video: Nat Geo Global Warming 101 (A)- https://www.youtube.com/watch?v=oJAbATJCugs
  - Read Dr. Suess's The Lorax: (A, M)
    - Introduce human impact on deforestation (effect on environment and biodiversity)
    - Identify stakeholders
    - 1972 Lorax (https://www.youtube.com/watch?v=FSSrYnc1yQs)
  - Global forest watch (M, T)
    - research and analyze deforestation data world-wide over time
      https://serc.carleton.edu/eslabs/carbon/4b.html
      https://www.globalforestwatch.org/map/4/32.59/17.16/ALL/grayscale/loss,forestgain,forest2000?tab=analysis-tab&begin=2001-01-01&end=2018-01-01&threshold=30&dont_analyze=true
  - Revisit cycles and how they are affected. (T)
- BIODIVERSITY
  - Effects of extinction
    - "The Endangered Debate" – (A, M)
  - Discuss culture/stakeholders/poaching/hunting on biodiversity (A)
  - BIODIVERSITY CONSERVATION PROJECT (A, M, T)
    - Research biodiversity hotspot
    - Identify threats to the hotspots key species
    - Discuss effects on food web/ecosystem from the extinction of a key species
    - Explain how culture and stakeholders play a role in the decrease of biodiversity
    - Suggest solutions for this hotspot to decrease rate of loss of biodiversity
    - Present research and proposed solutions as well as your justification for why it will work