Environmental Science 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
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UNIT OVERVIEW	
CONTENT AREA: Environmental Science	**UNIT 1: Biogeochemistry of Earth**
TARGET COURSE/GRADE LEVEL:	**SUGGESTION TIMEFRAME: 8-10 weeks**

Grade 10-12	
TOPIC: **Biogeochemical History of Earth**	**CHAPTERS COVERED: N/A**

UNIT SUMMARY/ UNIT RATIONALE:

In this unit students will investigate the interrelationships between organisms and their environment and examine cause and effect.
The first unit provides a framework for students of how life interacts with the physical and chemical Earth. Students will examine the parts of an ecosystem and learn how the organisms that make up an ecosystem are interconnected. They will be able to explain how changes to organisms in an ecosystem can impact biodiversity. The change over time that Earth has experienced in the past and the scale of ecological and geological change that is currently occurring (largely due to human actions) students will explore the influence of life on Earth and Earth on life over geologic time. Within this study of geological change, students will explore decadal scale climate fluctuations and patterns. As part of this study, students will use a growing understanding of biogeochemistry to learn about geologic eras and coevolution of the abiotic and biotic components of Earth. Students will explore how molecules necessary for life, such as carbon, nitrogen and phosphorus are constantly being cycled through ecosystems. Students will analyze how energy flows through an ecosystem. They will learn how to read and create models that show the flow of energy in an ecosystem. Students will develop an understanding of ecological systems including characteristics of major global and terrestrial ecosystems (biomes).

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

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)
- HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-5)

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)

- 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-LS1-3)
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-LS1-3)
- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-2)
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a selfgenerated 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-ESS2-5).

Computer Science and Design Thinking

• 8.1.12.DA. l Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

• 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

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

ESSENTIAL QUESTIONS:

- How does the environment operate naturally to provide the resources needed for a variety of organisms to live there?
- How are energy and matter transferred and transformed in an ecosystem?
- How do ecosystems establish themselves and how do they recover if disturbed?
- How is energy and matter cycled and conserved on Earth? How are organisms dependent on each other?
- Why was the development of single celled cyanobacteria so important to both the geologic and biologic evolution on Earth?
- Why were plants aquatic prior to the establishment of Earth's ozone layer?
- How does the current pace of change to the atmosphere, climate, chemistry and surface of the Earthcompare to what has happened in

the past?

- Why/how, do geologic events cause mass extinction?
- Why did the dinosaurs go extinct?
- How do human interactions with the environment impact the biodiversity found in ecosystems?
- How has human interaction with the environment demonstrated the power of humans to be bothdetrimental and helpful when dealing with environmental issues?
- How have the ways that human society has interacted with the environment affected the lives of peoplefrom around the world?
- To what extent does understanding the flow of matter and energy through living systems affect personal and public policy decisions?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. *[Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages of oceanic crust increasing with distance from mid- ocean ridges (a result of plate spreading) and the ages of North American continental crustincreasing with distance away from a central ancient core (a result of past plate interactions).]*

HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and otherplanetary surfaces to construct an account of Earth's formation and early history. *[Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), thesizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]*

HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. *[Clarification Statement: Examples of the causes ofclimate change differ by timescale, over 1–10 years: large volcanic eruption, ocean circulation; 10–100s of years: changes in human activity, ocean circulation, solar output; 10–100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10–100s of millions of years: long-term changes in atmospheric composition.]* [AssessmentBoundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]

HS-ESS2-7: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. *[Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which inturn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.]* [Assessment Boundary: Assessment

does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]

HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence- based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. *[Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).]* [Assessment Boundary: Assessment is limited to one example of climate change and its associated impacts.]

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 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 computationalmodels.]

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-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy 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 to describe thecycling of matter and flow of energy.]

HS-LS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere,atmosphere, geosphere, and biosphere. *[Clarification Statement: Emphasis is on modelingbiogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]*

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 ofnew 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.]* Teacher Note: Within this unit the focus of this SLO is on the relationship of various lifeforms found in the fossil record over geologic time and the environmental conditions within the Earth system which may have precipitated the changes in life forms.

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 issue such as climate change.
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.
9.1.12.CFR.3	Research companies with corporate governance policies supporting the common good and human rights.
9.4.12.TL.4	Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.

Content: What information do students need to know?	**Process: What will students be able to do with the information?**
ESS1: Earth's Place in the Universe ● **ESS1.C: The History of Planet Earth -** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **(HS-ESS1-5)** ● **ESS1.C: The History of Planet Earth -** Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studyingthese objects can provide information about Earth's formation and early history. **(HS-ESS1-6)** **ESS2: Earth's Systems** ● **ESS2.A: Earth Materials and Systems -** The geological record shows that changes to global and regionalclimate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. **(HS-ESS2-4)** ● **ESS2.D: Weather and Climate** - The foundation for Earth's global climate systems is the electromagneticradiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's reradiation into space. **(HS-ESS2-4)** ● **ESS2.D: Weather and Climate** -Gradual atmospheric changes were due to plants and other organismsthat captured carbon dioxide and released oxygen. **(HS-ESS2-7)** ● **ESS2.D: Weather and Climate** - Changes in the atmosphere due to human activity have increased carbondioxide concentrations and thus affect climate. **(HS-ESS2-4)** ● **ESS2.E: Biogeology** - The many dynamic and delicate feedbacks between the biosphere and other Earthsystems cause a continual coevolution of Earth's surface and the life that exists on it. (**HS-ESS2-7)** **ESS3: Earth and Human Activity** ● **ESS2.D: Weather and Climate** - Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend	● Develop an understanding of complex processes and relationships between the physical environment on Earth and the organisms that populate it. ● Use models to explain the interconnected relationships between organisms in an ecosystem. ● Use tools such as physical modeling to build a conceptual model of geological time and biogeochemical eras. ● Analyze the effect of major catastrophes, such as meteor impacts and massive volcanoes on extinctionsand subsequent evolution. ● Reconstruct climate records from ice cores, sediment data, and microfossils such as temperature,precipitation, atmospheric composition, volcanic activity, and wind patterns. ● Compare the current rate of extinction to the geological background rate and to mass extinctions. ● Contrast the effects of human contributions to extinctions of other species to those of natural processes. ● Assess the benefits of biodiversity to ecosystem stability and human wellbeing. Compare the population of people both regionally and globally to the population of threatened andendangered animals.

on the amounts of human-generated greenhouse gases addedto the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. **(secondary to HS-ESS3- 6)** ● **ESS3.D: Global Climate Change** - Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. **(HS- ESS3-5)** ● **ESS3.D: Global Climate Change** - Through computer simulations and other studies, important discoveriesare still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. **(HS-ESS3-6)** **LS2: Ecosystems: Interactions, Energy, and Dynamics** ● **LS2.A: Interdependent Relationships in Ecosystems -** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size wereit not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. **(HS-LS2-2)** ● **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** - A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. **(HS-LS2-2) (HS- LS2-6)** ● **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** - Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasivespecies, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. **(HS-LS2-7)** **LS4: Biological Evolution: Unity and Diversity** ● **LS4.C: Adaptation -** Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. **(HS-LS4-5)**	● Examine the challenges and opportunities for humans to positively influence natural systems in an effort to preserve biodiversity. ● Develop an understanding of the impact of human activities on the physical environment and the biosphere. ● Distinguish between the biotic and abiotic factors in an ecosystem ● Describe how a population differs from a species ● Explain how habitats are important to organisms. ● Describe how energy is transferred from the Sun to producers and then to consumers ● Describe one way in which consumers depend on producers. ● List two types of consumers ● Explain how energy transfer in a food web is more complex than energy transfer in a food chain ● Explain why an energy pyramid is a representation of trophic levels ● Describe one way that humans are affecting the carbon cycle ● List the three stages of the nitrogen cycle ● Describe the role that nitrogen-fixing bacteria play in the nitrogen cycle ● Explain how the excess use of fertilizer can

● **LS4.C: Adaptation -** 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 forthe species' evolution is lost. **(HS-LS4-5)** ● **LS4.D: Biodiversity and Humans** - Biodiversity is increased by the formation of new species (speciation)and decreased by the loss of species (extinction). **(HS-LS2-7)** ● **LS4.D: Biodiversity and Humans** - Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivityare maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. **(HS-LS2-7)**	affect the nitrogen and phosphorus cycles ● List two types of ecological succession ● Explain how a pioneer species contributes to ecological succession ● Describe how lichens contribute to primary succession ● Describe why vegetation is used to describe a biome ● Explain how temperature and precipitation determine which plants grow in an area ● Explain how latitude and altitude affect which plants grow in an area ● List three characteristics of tropical rainforests ● Name and describe the main layers of a tropical rainforest ● Describe one plant in a temperate deciduous forest and an adaptation that helps it survive ● Describe one adaptation that may help an animal survive in a taiga ● Describe the difference between tropical and temperate grasslands ● Describe two desert animals and the adaptations that help them survive ● Describe one threat to the tundra biome

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 tasks Self-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

Ecology
Ecosystem
Biome
Abiotic factor/Biotic factor
Carrying capacity
Biodiversity
Conservation
Habitat fragmentation
Predator and Prey relationship
Population
Community
Competition
Producer/Consumer
Decomposer
Energy pyramid
Biomass Pyramid
Number pyramid
Exponential Growth/Logistic growth

Food chain/Food Web Habitat/Niche Trophic Levels Limiting factors Nitrogen fixation Photosynthesis Invasive species Keystone species Hydrologic cycle Carbon cycle Oxygen cycle Nitrogen cycle Greenhouse effect Greenhouse gas Smog Acid rain Altitude Canopy Chaparral Epiphyte Latitude Permafrost Savannah Taiga Temperate deciduous forest Temperate grassland Temperate rainforest Tropical rainforest Tundra Benthic zone Coral reef Estuary littoral zone Plankton Wetland

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks

- Evaluate the merits and limitations of various models that illustrate the stability and change that occurs during the geologic eras. Students will use this knowledge as evidence to construct an account of Earth's formation and early history. (HS-ESS1-5) (HS-ESS1-6) (HS-ESS2-4)
- Present an oral and written argument based on data and evidence that illustrates the cause and effect relationship that is apparent in the simultaneous coevolution of Earth's systems and life on Earth (HS- ESS2-7)
- Develop and use a model based on biogeochemical cycles to explore the stability and change of the planetas the co-evolution of Earth's surface and the life that exists on it occurred. (HS-ESS2-7) (HS-LS2-6)
- Obtain, evaluate and communicate the cause and effect relationship that changes in environmentalconditions may result in the extinction of species. (HS-LS4-5) (HS-LS2-6) (HS-ESS3-6)
- Analyze data from global climate models to make predictions about the current rate of global climate change and the associated future impacts to Earth's systems. (HS-ESS3-5)
- 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)**
- 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 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):

Deepl.com (English to Spanish)
Teacher created hands on activities.
Student resources on Google classroom.
Khan Academy
You tube videos
Lab manuals

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resource

UNIT OVERVIEW

CONTENT AREA: **Environmental Science**	**UNIT 2: The Ecological Footprint**
TARGET COURSE/GRADE LEVEL: **Grade 10-12**	**SUGGESTION TIMEFRAME: 5 – 6 weeks**
TOPIC: The Ecological Footprint	**CHAPTERS COVERED: N/A**

UNIT SUMMARY/ UNIT RATIONALE:

This unit examines the role of personal decisions on environmental issues. In this unit students will study the chemical composition of the atmosphere and the role it plays in maintaining a livable biosphere. This unit will focus on climate and the greenhouse effect and how energy production is influencing the atmosphere. Students are asked to explore how decisions about consumption and habits are made and how they influence issues of environmental concern. They will address the effect of their own personal decisions and those of other individuals on the eco-footprint of their community and society. They will compare and contrast the role of individuals and institutions.

Students will develop an understanding of human population dynamics and the size of the human population. Total human impact on the environment is enormous when taking into account the size and distribution of the human population across the globe, the additive effect of unavoidable human consumption and waste, and theaddition of discretionary use of nonrenewable resources.

This unit will see students explore, explain, and evaluate the most potentially impactful environmental issuesthat human activity is influencing and that pose challenges and opportunities currently and in the coming century. They will analyze and interpret data and scientific models related to the environmental impacts of sustaining our growing population and the short-term and long-term consequences for Earth.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

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)
• HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1), (HS-ESS1-2), (HS-ESS1-4), (HS-ESS1-5), (HS-ESS1-6) New Jersey Department of Education January 2022 Page 185 of 200
• 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)

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 selfgenerated 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)
• 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)
• SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1), (HS-LS4-2)

Computer Science and Engineering Design Thinking

• 8.1.12.DA. l Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
• 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
• HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
• HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
• HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
• HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

ESSENTIAL QUESTIONS:

- What factors have allowed the human population to greatly increase?
- To what extent do human behaviors impact our planet's life support system (environment)?
- What is the greenhouse effect and how does it work?
- What are positive feedback systems and how are they influencing warming?
- What are the most pressing environmental problems that are due to human impact?
- How do people make decisions?
- How does the size of the human population influence the importance of decisions?
- What is the environmental impact of individual decisions and societal decisions?
- What actions can be taken at a personal or local level to enact positive change?
- Are the proposed changes for more sustainable resource use and disposal realistic for allcommunities/countries/populations?
- Are the United Nations Sustainable Development Goals attainable for all populations?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change 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 mineralsand 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 changesin 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 naturalresources, 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.]

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 ofhuman 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 impactscould range from local efforts (such as reducing, reusing, and recycling resources) to large-scalegeoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).] - In this unit, this performance expectation focuses on an overview of impacts of human activities.

HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and howthose 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 humanactivity is how an increase in atmospheric carbon dioxide results in an increase in photosyntheticbiomass 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.] - In this unit, this performance expectation focuses on an overview of modeling human impacts on natural systems.

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

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

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well aspossible social, cultural, and environmental impacts.

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

9.1.12.EG.5	Relate a country's economic system of production and consumption to building personal wealth,the mindset of social comparison, and achieving societal responsibilities
9.1.12.PB.2	Prioritize financial decisions by considering alternatives and possible consequences.
9.1.12.PB.4	Explain how you would revise your budget to accommodate changing circumstances.
8.2.12.B.2	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
8.2.12.B.5	Research the historical tensions between environmental and economic considerations as drivenby human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and humanfactors engineering (ergonomics).
8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
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?

ESS2: Earth's Systems

- **ESS2.D: Weather and Climate -** Current models predict that, although future regional climate changeswill be complex and varied, average global temperatures will continue to rise. The outcomes predictedby global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. **(secondary**

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

- Evaluate human demands on natural resources.
- Use risk assessment to evaluate environmental issues, and set priorities for decision making
- Examine some of the most pressing environmental issues in relation to their prevalence and importance

to HS-ESS3- 6)

ESS3: Earth and Human Activity

- **ESS3.A: Natural Resources -** Resource availability has guided the development of human society. **(HS-ESS3-1)**.
- **ESS3.B: Natural Hazards -** Natural hazards and other geologic events have shaped the course of humanhistory; [they] have significantly altered the sizes of human populations and have driven human migrations. **(HS-ESS3-1)**
- **ESS3.C: Human Impacts on Earth Systems -** The sustainability of human societies and the biodiversitythat supports them requires responsible management of natural resources. **(HS-ESS3-3)**
- **ESS3.C: Human Impacts on Earth Systems -**Scientists and engineers can make major contributions bydeveloping technologies that produce less pollution and waste and that preclude ecosystem degradation. **(HS-ESS3-4)**
- **ESS3.D: Global Climate Change -** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact andare modified in response to human activities. **(HS-ESS3-6)**

LS2: Ecosystems: Interactions, Energy, and Dynamics

- **LS2. A: Interdependent Relationships in Ecosystems -** Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size wereit not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. **(HS-LS2-1)**
- **ET S1.A.HS.2: Defining and Delimiting Engineering Problems -** Humanity faces major global challengestoday , such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **(HS-ETS1-1)**

at local, regional, and global scales. These include: land use and loss/degradation of habitat, invasive species, wetland loss, etc. Evaluate current solutions to environmental problems at the local, regional, and global level.

- Use principles of dynamics to explain trends in human populations over historical time and make predictions into the future.
- Explain the history of human energy consumption with particular reference to the Industrial Revolution and our increasing dependence on fossil fuels.
- Examine how the growing human population is contributing to global climate change.
- Discuss the "Tragedy of the Commons" as an example of individual decisions affecting group results andhow this concept relates to environmental science.
- Relate ecosystem services to environmental commons and decisions made about private and public property.
- Use decision making models and processes including cost/benefit analysis and show ethical considerations fit into decision making.
- Argue from evidence that urbanization is either a net positive or net negative for ecological footprints of individuals and populations.
- Compare the ecological footprint of someone living in a developed versus a developing/third world country; describe the reasons why the footprint is different. Discuss needs and wants as they relate to ecological footprints.
- Develop an understanding of sustainability, and ways

- **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. **(secondary to HS-ESS3- 2), (secondary HS-ESS3-4)**
- **ET S1.B.HS.1: 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. **(HS-ETS1-3)**
- **ET S1.B.HS.2: Defining and Delimiting Engineering Problems -** Both physical models and computers canbe used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one ismost efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. **(HS-ETS1-4)**
- **ET S1.C.HS.1: Optimizing the Design Solution** - Criteria may need to be broken down into simpler onesthat can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. **(HS-ETS1-2)**

in which humans can reduce their impact on ecosystems and watersheds.

- Compare the greenhouse effect caused by the Earth's greenhouse gas layer to the greenhouse effect of other planets like Venus and Mercury and to that of a glass greenhouse used to grow plants.
- Analyze carbon dioxide and other greenhouse gas levels to explore the effect of industrialization and human population growth on the atmosphere.
- Contrast natural and human generated sources of methane and suggest ways to reduce human generation of this greenhouse gas.
- Use the concept of positive feedback to explore how different regions of the planet may contribute to and be affected by 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 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 tasksSelf-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

Carrying capacity
Life expectancy
Fertility rate
Growth rate
Exponential growth
Population densities
Population growth
Population dispersion
Overpopulation
Mortality rate
Demographic transition
Pronatalist
Antinatalist
Dust Bowl
Green Revolution
Carbon footprint
Sustainability
Tragedy of commons
Technological fix
Evaluate and respond
Gloom and doom
Anthropocentric
Biocentric
Ecocentric
Environmental justice
Urban planner
Infill development
Smart growth
Green building
Environmental legislation

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Obtain and evaluate data on the rise and fall of various human societies. Use algebraic thinking to examine the data and predict how resource

availability has guided the development of human society. **(HS-ESS3-1)**

- Analyze data and use mathematical models to make a claim that resource availability is a factor that affects the carrying capacity of an ecosystem. **(HS-LS2-1)**
- Use principles of population dynamics to evaluate the claim that the rate of change modeled over short and long periods of time indicates that the human population has reached the carrying capacity determined by the availability of living and nonliving resources. **(HS-ESS3-3)**
- Engage in argument from evidence on the efficacy of systems that are designed to reduce the impacts ofhuman activities on natural systems. **(HS-ESS3-4)**
- Design solutions for the population to produce less pollution and waste to allow for stability and positivechange at local, regional, and national levels. **(HS-ESS3-4)**
- Use computer simulations, like an ecological footprint calculator, to explore the cause and effect relationships that exist when the ocean, atmosphere, and biosphere interact and how they are modifiedin response to human activities. **(HS-ESS3-6)**

Summative assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project 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):

Text Book
Deepl.com (English to Spanish)
Teacher created hands on activities.
Student resources on Google classroom.
Khan Academy
You tube videos
Lab manuals

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: **Environmental Science**	**UNIT 3: Land and Water Use**
TARGET COURSE/GRADE LEVEL: **Grade 10-12**	**SUGGESTION TIMEFRAME: 8- 9 weeks**
TOPIC: Land and Water Use	**CHAPTERS COVERED: N/A**

UNIT SUMMARY/ UNIT RATIONALE:

This unit describe the distribution of Earth's resources and explain the cycles associated with their interaction with each other. Students will study about the distribution of water resources, the relationship between groundwater and surface water, global water use, how water is treated for consumption, how dams and water diversion projects are used to manage freshwater resources and water conservation. Additionally, students will study how pollution such as smog affects land and the atmosphere. This pollution affects the Earth in several ways. Finally, students will learn about agriculture and learn major causes of malnutrition and famine.

This unit focuses on land use decisions by humans and the impact of land use on surrounding ecosystems. Students develop models and explanations for the ways that feedbacks between different Earth systems control the appearance of Earth's surface, and how humans impact those systems. Students will learn about the different ways that humans use lands, urban, suburban, and rural land use and the various methods of land management and conservation. The urban heat island effect, the environmental effects of deforestation, and the connection between land use and biodiversity will be discussed. Student projects will include creating land use models, soil experiments, and researching local land use issues.

Students will also focus on water use, availability, and pollution within and between these systems.They will critically analyze the sustainability of various land and water use practices and work to identify best practices for the sustainability of natural systems on a local, regional and global scale. In this unit, students will study how our freshwater supply is replenished,current uses of freshwater, and the growing concern about the vulnerability and pollution of this essential resource. They will explore how human activity directly impacts the health of naturally occurring marine ecosystems. They will also critically analyze current policies on water use, protection, and allocation.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

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)
• HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1), (HS-ESS1-2), (HS-ESS1-4), (HS-ESS1-5), (HS-ESS1-6) New Jersey Department of Education January 2022 Page 185 of 200
• 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)

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 selfgenerated 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)
• 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)
• SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1), (HS-LS4-2)

Computer Science and Engineering Design Thinking
• 8.1.12.DA. l Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

• 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
• HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
• HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
• HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
• HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

ESSENTIAL QUESTIONS:

- How does land use affect nearby ecosystems and global Earth systems?
- How can humans use natural resources sustainably?
- Where does our tap water come from? Where does our water go after it goes down the drain?
- How is the food you eat produced?
- How are parts of Earth (land, air, and water) related?
- Where and why are certain areas used for food production and others not?
- What kinds of food take the most land and other resources to produce and why?
- What kind of crops can be grown in our local region?
- How do regional and seasonal weather affect both agriculture and freshwater supply?
- What should one eat that meets nutritional needs and has the least environmental impact?
- What are the best practices in food production that both produce large quantities and limit ecologicaldamage?
- How can the availability of food and water affect population size?
- How can we best influence land use patterns to limit climate change?
- What factors contribute to the problem that our usable fresh water supply is in danger of running out?
- How does public policy influence the allocation of natural resources, such as water?
- How should water be distributed so individuals depending on it receive a fair allocation?
- How does water pollution impact organisms in an ecosystem, including humans?
- To what extent does public policy affect the pollution of freshwater resources?
- In what ways can society prevent and reduce the current amount of water pollution?
- What factors influence the replenishment and restoration of water and soil?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. *[Clarification*

Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or meltgeneration (by examining how water lowers the melting temperature of most solids).]

HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change 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 mineralsand 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 changesin 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-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. *[Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not whatshould happen.]* - In this unit this performance expectation focuses on the impact of agricultural practices on soil and water.

HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of naturalresources, 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.]

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 ofhuman 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 impactscould 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).] - In this unit, this performance expectation focuses on an overview of impacts of human activities.

HS-ESS3-6: Use a computational representation to illustrate the relationships among Earth systems and howthose 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 humanactivity is how an increase in atmospheric carbon dioxide results in an increase in photosyntheticbiomass 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.] - In this unit, this performance expectation focuses on an overview of modeling human impacts on natural systems.

HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem*[Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomassto 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 to describe the cycling of matter and flow of energy.]

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

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

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well aspossible social, cultural, and environmental impacts.

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

8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan ofinvestigation with peers and experts synthesizing information from multiple sources.
8.2.12.B.2	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution orinformation age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.B.5	Research the historical tensions between environmental and economic considerations as drivenby human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and humanfactors engineering (ergonomics).

8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
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?

ESS2: Earth's Systems

- **ESS2.E: The Roles of Water in Earth's Surface Processes** - The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. Theseproperties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. **(HS-ESS2-5)**
- **ESS2.D: Weather and Climate -** Current models predict that, although future regional climate changeswill be complex and varied, average global temperatures will continue to rise. The outcomes predictedby global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. **(secondary to HS-ESS3- 6)**

ESS3: Earth and Human Activity

- **ESS3.A: Natural Resources -** Resource availability has guided the development of human society. **(HS-ESS3-1)**
- **ESS3.A: Natural Resources -** All forms of energy production and other resource extraction have associatedeconomic, social, environmental, and

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

- Explore the physical factors and processes that contribute to cycling of water (focus on transpiration and groundwater movement).
- Examine data from an ecosystem or region to explore changes in a water cycle caused by different land use patterns.
- Compare the challenges of obtaining fresh water for human use in different climatic regions (focusing on irrigation and drainage).
- Use scientific tools and techniques to evaluate the health of a local aquatic system. Infer from data thehuman impact on local water quality.
- Explore the ways that human activities can pollute natural water sources.
- Explore the dangers of water pollution in residential areas and how local and regional governments respond to disasters.
- Explore and propose different solutions for

geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. **(HS-ESS3-2)**

- **ESS3.C: Human Impacts on Earth Systems -** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **(HS-ESS3-4)**
- **ESS3.D: Global Climate Change -** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. **(HS-ESS3-6)**

ETS1: Engineering Design

- **ET S1.A: Defining and Delimiting Engineering Problems -** Humanity faces major global challenges today , such as the need for supplies of clean water and food or for energy sources that minimize pollution, whichcan be addressed through engineering. These global challenges also may have manifestations in local communities. **(HS-ETS1-1)**
- **ET S1.C: Optimizing the Design Solution** - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. **(HS-ETS1-2)**
- **ET S1.B: Developing Possible Solutions -** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety , reliability , and aesthetics, and to consider social, cultural, and environmental impacts. **(HS-ETS1-3), (secondary to HS-ESS3-2)**

wastewater treatment and cleanup of polluted bodies of water.

- Discuss current environmental policies and regulations as they relate to freshwater use and pollution.
- Analyze the contribution of human generated carbon dioxide emissions on ocean acidity and the health of marine ecosystems.
- Describe conventional agricultural methods of growing crops and producing animal products for human consumption.
- Compare the advantages and disadvantages of the green revolution.
- Debate the advantages and disadvantages of genetic engineering (pesticide and herbicide resistance).
- Compare conventional and alternative methods of pest and weed control.
- Contrast how soil fertility is maintained in conventional and organic farming.
- Contrast soil formation in different climate and biome systems in terms of chemical, biological and physical weathering of parent material.
- Design a best practice set of features for preventing soil erosion and degradation on a model farm.
- Analyze how changes to weather and climate have affected soil productivity in different regions.

Modifications:

Special Education	ESL	At-risk	Gifted and Talented
Word walls Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries	Scaffolding Word walls Read aloud Bilingual dictionaries Bilingual translation Sentence frames Key vocabulary	Teacher tutoring Peer tutoring Study guides Graphic organizers Modified assignments Extended time	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Collaborative team

Visual aides Answer masking Answer eliminator Highlighter Color contrast Extended time	Annotation guides Think-pair-share Visual aides		work Higher level questioning Critical/Analytical thinking tasksSelf-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

Anthropogenic
Sustainability
Tragedy of commons
Renewable resources
Nonrenewable resources
Environmental legislation
Pollutant
Ocean acidification
Coral bleaching
GMO
Crop rotation
Monoculture
Erosion
Turbidity
Salinity
Dissolved oxygen
Acid rain
pH
Eutrophication
Run off
Transpiration
Green revolution
Genetic engineering
Irrigation
Tiling
Artificial eutrophication
Biomagnification

Dam
Desalination groundwater
Nonpoint-source pollution
Pathogen
Permeability
Point-source pollution
Porosity
Recharge zone
Reservoir
River system
Surface water
Thermal pollution
Wastewater
Water pollution
Watershed

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks -

- Analyze and interpret data on the abundance of liquid water on Earth's surface to explain the cause andeffect outcomes of the overconsumption of natural water resources. **(HS-ESS2-5)**
- Construct explanations and design solutions for the causes of water pollution by developing technologies that produce less pollution and waste than can have an impact on a small or large scale. **(HS-ESS3-4)**
- Develop a model that illustrates the flow of matter that occurs during the cycling of carbon among the biosphere, atmosphere, hydrosphere and geosphere. **(HS-ESS2-6)**
- Compare and evaluate competing arguments weighing the advantages and disadvantages of genetic engineering (pesticide and herbicide resistance) as a component of the system designed to produce foodas a way to address humanity's major global challenges of food availability. **(HS-ESS3-4)**
- Analyze and interpret data from recent natural hazards (such as increased wildfires, more extreme droughts) to explain how recent changes in the scale, proportion, and quantity of these events influencesour resource use for food production. **(HS-ESS3-2)**
- Compare and evaluate competing arguments weighing the advantages and disadvantages of freshwater allocation as a component of the system designed to produce food in locations experiencing extreme drought. **(HS-ESS2-5) (HS-ESS3-1)**
- Engage in argument from evidence how pollution in bodies of water can make its way into living organisms and cause developmental problems for those who consume it. **(HS-ESS3-6)**

Summative assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project 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):

Deepl.com (English to Spanish)
Teacher created hands on activities.
Student resources on Google classroom.
Khan Academy
You tube videos
Lab manuals

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: **Environmental Science**	**UNIT 4: Climate Change and Solutions**
TARGET COURSE/GRADE LEVEL: **Grade 10-12**	**SUGGESTION TIMEFRAME: 6-7 weeks**
TOPIC: Climate Change and Solutions	**CHAPTERS COVERED: N/A**

UNIT SUMMARY/ UNIT RATIONALE:

This unit focuses on Earth's climate and climate change. Students first learn about the difference between weather and climate, and then analyze New Jersey state climate data to determine long term trends and changes. Next, various types of evidence of climate change will be explored through data-based student projects, with an emphasis on identifying positive and negative feedback loops. Examples of feedback include how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, thus reducing the amount of sunlight reflected from Earth's surface, which in turn increases surface temperatures and further reduces the amount of ice. Students will then go on to learn about causes of climate change on Earth, beginning with natural causes of long-term and short-term climate change, such as volcanic eruptions and changes in Earth's orbit, and then moving on to the greenhouse effect and the increase of atmospheric greenhouse gas levels. Students will investigate the connection between the carbon cycle, combustion of fossil fuels and deforestation, atmospheric carbon dioxide levels, and global temperatures through computer model simulations and experiments. Finally students will explore various adaptation and mitigation solutions to climate change, focusing on solutions that are currently being implemented or considered in New Jersey. Example mitigation solutions include technologies such as electric vehicles, hydrogen fuel cell vehicles, wind turbines, and advanced battery designs.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

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)
• HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1), (HS-ESS1-2), (HS-ESS1-4), (HS-ESS1-5), (HS-ESS1-6) New Jersey Department of Education January 2022 Page 185 of 200
• 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)

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 selfgenerated 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)
• 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)
• SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1), (HS-LS4-2)

Computer Science and Engineering Design Thinking
• 8.1.12.DA. l Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.

• 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
• HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
• HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
• HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
• HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

ESSENTIAL QUESTIONS:

- How is our climate changing?
- Why is our climate changing?
- How is New Jersey reducing and preparing for climate change?
- How has human activity amplified the effects of the greenhouse effect?
- Why is the arctic warming twice as fast as the rest of the planet?
- What is being done to help slow and/or reduce the warming of the Earth?
- How are positive feedback systems, amplified by human activity, influencing warming?
- What are people doing that is contributing to climate change?
- How do measures taken to reduce our ecological footprints meet the mission of the Sustainable Development Goals?
- How will climate change solutions impact biodiversity
- How are increased global temperature and decreased precipitation necessitating changes to agricultural practices?
- How can we best influence land use patterns to slow the effects of climate change?
- What is biomass and what are the benefits of using it as an alternative form of energy?
- How are changes to weather patterns impacting both our community and communities around the world?
- Which populations are most at risk from the effects of climate change?
- How does allocation of resources affect a community's ability to adapt to our changing climate?
- How are different countries and organizations working together to solve the climate crisis?
- What are some of the potential benefits & drawbacks to changing our electrical power generation infrastructure?
- What alternative energy options are best suited for our community?
- How does a community implement a sustainable waste management and waste disposal system?
- What are the economic impacts of transitioning society from fossil fuels to cleaner alternatives?
- How will climate change impact career opportunities? (i.e. agriculture, energy sector, conservation, etc.)

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change 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 mineralsand 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 changesin 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-ESS3-4: 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 ofhuman 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 impactscould range from local efforts (such as reducing, reusing, and recycling resources) to large-scalegeoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).] - In this unit, this performance expectation focuses on an overview of impacts of human activities.

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 humanactivity is how an increase in atmospheric carbon dioxide results in an increase in photosyntheticbiomass 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.] - In this unit, this performance expectation focuses on an overview of modeling human impacts on natural systems.

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

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

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well aspossible social, cultural, and environmental impacts.

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

8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1	Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
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?

ESS2: Earth's Systems

- **ESS2.D: Weather and Climate -** Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predictedby global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. **(secondary to HS-ESS3- 6)**

ESS3: Earth and Human Activity

- **ESS3.A: Natural Resources -** Resource availability has guided the development of human society. **(HS-ESS3-1)**.

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

- Compare the greenhouse effect caused by Earth's greenhouse gas layer to possible technological solution for growing crops in extreme conditions on Earth and eventually on Mars.
- Propose solutions to the current levels of atmospheric carbon dioxide and other greenhouse gases as a result of industrialization and human population growth.
- Compare and contrast the environmental impact of the Industrial Revolution of the 1880s to the current digital technological revolution.
- Contrast natural and human generated sources of

- **ESS3.B: Natural Hazards -** Natural hazards and other geologic events have shaped the course of humanhistory; [they] have significantly altered the sizes of human populations and have driven human migrations. **(HS-ESS3-1)**
- **ESS3.C: Human Impacts on Earth Systems -** The sustainability of human societies and the biodiversitythat supports them requires responsible management of natural resources. **(HS-ESS3-3)**
- **ESS3.C: Human Impacts on Earth Systems -**Scientists and engineers can make major contributions bydeveloping technologies that produce less pollution and waste and that preclude ecosystem degradation. **(HS-ESS3-4)**
- **ESS3.D: Global Climate Change -** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. **(HS-ESS3-6)**

LS2: Ecosystems: Interactions, Energy, and Dynamics

- **ET S1.A.HS.2: Defining and Delimiting Engineering Problems -** Humanity faces major global challengestoday , such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. **(HS-ETS1-1)**
- **ETS1.B: Developing Possible Solutions** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. **(secondary to HS-ESS3- 2), (secondary HS-ESS3-4)**

methane and suggest ways to reduce human generation of this greenhouse gas.

- Draw and explain how different regions of the planet contribute to and are affected by climate change through a positive feedback model.
- Engage in argument from evidence (e.g. climate data) as to why Earth's climate will continue to get warmer unless interventions are made.
- Evaluate the pros and cons of current water allocation and distribution policies as impacted by current climate models for a variety of stakeholders.
- Propose solutions to the current contribution of human generated carbon dioxide emissions on ocean acidity and the health of marine ecosystems.
- Discuss the role of human population level changes in e nergy use and efficiency in addressing the energy sectors' effect on human health and environmental issues.
- Discuss the environmental short comings of waste disposal methods and propose solutions to lessen their impact.
- Compare and contrast the extraction and transportation methods for different fossil fuels to the extraction installation of alternative energy technology.
- Debate the merits of emerging motor vehicle power technologies such as hydrogen, electric battery, hybrid gas-electric, and turbo diesel.
- Predict how the integration of alternative energy options and atmospheric carbon emissions will change the current carbon cycle if fossil fuel use is reduced.
- Compare and contrast the technology differences between fossil fuel based methods for generating electricity to low carbon technologies such as wind,

	solar photovoltaic, hydro, nuclear fission, biomass, and geothermal. • Discuss the role communities play in bringing about changes to policy as it relates to the environment. • Propose environmentally friendly and sustainable solutions for our community.

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 tasksSelf-directed activities Independent research/inquiry

INSTRUCTION

CONTENT VOCABULARY:

Surface temperatures
Surface level ozone
Greenhouse gases
Greenhouse effect
Fossil fuel
Precipitation
Particulates
Smog
Alternative energy resources
Photovoltaic
Nuclear fission

Geothermal
Biocentric
Ecocentric
Environmental justice
Risk assessment
Urban planner
Infill development
Smart growth
Green building
Environmental legislation

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks:

- Design solutions for current climate change issues, based on patterns from the past, by modeling, predicting, and managing current and future impacts (HS-ESS3-5)
- Communicate scientific and/or technical information describing an energy source that minimizes pollution in an effort to identify patterns of performance of designed systems for generating electricity. (HS-ESS3-2)
- Engage in argument from evidence about the pros and cons of alternative energy options as they relate to stability and change within an ecosystem. (HS-LS2-7) (HS-ESS3-4)
- Develop and use models of technologies that produce less pollution and waste in order to demonstrate their ability to affect stability and change in the global climate. (HS-ESS3-4)
- Engage in argument from evidence about how natural hazards have and will shape the course of human history at various scales. (HS-ESS3-1)
- Obtain information about a local incinerator and evaluate the current environmental regulations in place as they affect the systems within nearby c ommunities. (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 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):

Deepl.com (English to Spanish)
Teacher created hands on activities.
Student resources on Google classroom.
Khan Academy
You tube videos
Lab manuals

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

UNIT OVERVIEW	
CONTENT AREA: **Environmental Science**	**UNIT 5: Extraction of renewable and non-renewable resources**
TARGET COURSE/GRADE LEVEL: **Grade 10-12**	**SUGGESTION TIMEFRAME: 5-6 weeks**
TOPIC: Extraction of renewable and non-renewable resources	**CHAPTERS COVERED: N/A**

UNIT SUMMARY/ UNIT RATIONALE:

In unit 5, students will learn about minerals - types of minerals, how they form, how humans extract minerals from the Earth through different types of mining, and the potential impacts and consequences of mining. Students will also gain a deeper understanding of nonrenewable resources, such as fossil fuels and nuclear energy as well as renewable resources such as solar energy and hydroelectricity. In the final chapter of this unit, students will study waste - types of waste produced by humans, how to reduce solid waste, and the types of hazardous waste.

Nonrenewable resources are vitally important to all societies. Throughout modern history, humans have used mineral deposits and rawmaterials for m anufacturing as well as fossil fuels as high energy resources.In this unit, students will learn about historical and modernextraction, use, and disposal of these nonrenewable resources.Discovering where the materials that make everyday products come from is important because there are many environmental issues that can occur when extracting certain materials from the Earth. Thereare also issues that can arise from the uses of extracted materials, such as fossil fuels.Once fossil fuels are extracted from the Earth,theburning of them for energy has major impacts on carbon dioxide levels in the atmosphere. Fossil fuels are nonrenewable resources and will not be able to sustain the human need for them as a source of energy in the near future. When other existing resources need to be disposed of, there are a variety of methods that humans have invented. This has led to issues with waste management and will lead to students designing ways in which the human population can reduce waste production.

INTERDISCIPLINARY CONNECTIONS / PROBLEM-BASED LEARNING:

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)

• HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1), (HS-ESS1-2), (HS-ESS1-4), (HS-ESS1-5), (HS-ESS1-6) New Jersey Department of Education January 2022 Page 185 of 200
• 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)

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 selfgenerated 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)
• 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)
• SL.11-12.4 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-LS4-1), (HS-LS4-2)

Computer Science and Engineering Design Thinking
• 8.1.12.DA. l Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change.
• 8.1.12.DA.5 Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.

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

ESSENTIAL QUESTIONS:

- How do we get the metals that go into products we use?
- How is the extraction of resources managed? What regulations are in place for environmental protection?
- How were fossil fuels formed? How do we get each type of fossil fuel from where it is found to where we are going to use it?
- What are the environmental impacts of extracting, processing and transporting metals and fossil fuels?
- What are the environmental implications of extracting resources from protected lands?
- What are the pros and cons of approving new land for resource extraction?
- What are the health impacts of mining practices?
- In what ways do humans manage waste production and what can be done to reduce it?
- What are the environmental impacts of putting waste into landfills?
- What are the health impacts of improper waste disposal?

LEARNING TARGETS

NEW JERSEY STUDENT LEARNING STANDARDS:

HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change 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 mineralsand 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 changesin 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-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. *[Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales),*

and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not whatshould happen.] - In this unit this performance expectation focuses on the impact of agricultural practices on soil and water.

HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of naturalresources, 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.]

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 ofhuman 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 impactscould 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).] - In this unit, this performance expectation focuses on an overview of impacts of human activities.

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

9.1.12.EG.3	Explain how individuals and businesses influence government policies.
9.1.12.EG.5	Relate a country's economic system of production and consumption to building personal wealth,the mindset of social comparison, and achieving societal responsibilities
9.1.12.PB.2	Prioritize financial decisions by considering alternatives and possible consequences.
8.2.12.B.2	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution orinformation age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.B.5	Research the historical tensions between environmental and economic considerations as drivenby human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
8.2.12.C.3	Analyze a product or system for factors such as safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, and humanfactors engineering (ergonomics).
8.2.12.D.4	Assess the impacts of emerging technologies on developing countries.
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?

ESS2: Earth's Systems

- **ESS2.E: The Roles of Water in Earth's Surface Processes** - The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. Theseproperties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. **(HS-ESS2-5)**
- **ESS2.D: Weather and Climate -** Current models predict that, although future regional climate changeswill be complex and varied, average global temperatures will continue to rise. The outcomes predictedby global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. **(secondary to HS-ESS3- 6)**

ESS3: Earth and Human Activity

- **ESS3.A: Natural Resources -** Resource availability has guided the development of human society. **(HS-ESS3-1)**
- **ESS3.A: Natural Resources -** All forms of energy production and other resource extraction have associatedeconomic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. **(HS-ESS3-2)**
- **ESS3.C: Human Impacts on Earth Systems -** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. **(HS-ESS3-4)**

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

- Argue for a method of mining and/or refining metals that is the most ecologically and societally preferable.
- Discuss the benefits and problems associated with an increase in consumer electronics as related to the extraction and disposal of rare earth materials.
- Compare and contrast methods of mine reclamation and discuss the long term effects of these extractions.
- Explain the chemical process of fossil fuel generation and compare the energy content and structure of biological molecules and fossil fuels.
- Compare extraction and transportation methods for different fossil fuels such as coal, oil and natural gas.
- Discuss the limitations of different fossil fuels to sustain our need for power generation as the population continues to grow.
- Choose a method for disposal of paper, plastic or metal waste and argue from evidence that it is the best method.
- Design a set of best practices for landfill construction and waste disposal.
- Compare and contrast strategies of waste management versus waste reduction.
- Analyze waste management and waste reduction systems for factors such as safety, reliability, economic

• **ESS3.D: Global Climate Change -** Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. **(HS-ESS3-6)** **ETS1: Engineering Design** • **ET S1.A: Defining and Delimiting Engineering Problems -** Humanity faces major global challenges today , such as the need for supplies of clean water and food or for energy sources that minimize pollution, whichcan be addressed through engineering. These global challenges also may have manifestations in local communities. **(HS-ETS1-1)** • **ET S1.C: Optimizing the Design Solution** - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. **(HS-ETS1-2)** • **ET S1.B: Developing Possible Solutions -** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety , reliability , and aesthetics, and to consider social, cultural, and environmental impacts. **(HS-ETS1-3), (secondary to HS-ESS3-2)**	considerations, quality control, and environmental concerns. • Discuss human health challenges arising from human caused or naturally occurring chemical hazards such as radon exposure, excessive fluoride in water, lead etc.

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 tasksSelf-directed activitie Independent research/inquiry

INSTRUCTION
CONTENT VOCABULARY: Renewable resources Nonrenewable resources Environmental legislation Electric generator Fossil fuels Mineral Nuclear energy Nuclear fission Nuclear fusion Oil reserves Ore mineral Petroleum Placer deposit Reclamation Surface mining Mining Radioactive half-life Landfill VOC Active solar heating biomass fuel Alternative energy Energy conservation Energy efficiency Geothermal energy Hydroelectric energy Passive solar heating Renewable energy Biodegradable landfill Compost Deep-well injection Hazardous water Municipal solid waste Recycling Solid waste source reduction

Surface impoundment

ASSESSMENTS (BENCHMARK, FORMATIVE, SUMMATIVE, ALTERNATIVE):

Sample Performance Tasks -

- Argue from evidence for a method of mining that is most ecologically and societally preferable, with an understanding that the system that is resource extraction will always have an amount of economic, social, environmental, and geopolitical costs. (HS-ESS3-2)
- Engage in a stakeholders debate and argue from evidence about the opening of federally protected land for resource extraction and how this relates to feedback within Earth's natural systems. (HS-ESS2-2)
- Plan and carry out an investigation on the structure and function of landfills to better understand the effects of improper landfill creation an d management on the surrounding ecosystem. (HS-ESS3-4)
- Construct explanations and design solutions for ways to manage and reduce waste production by developing technologies that produce less pollution and waste at different scales, proportions, and quantities. (HS-ESS3-4) (HS-ETS1-2)
- Analyze and interpret data in order to determine the cause and effect relationship between the availability and burning of fossil fuels as an energy source for human society and its impacts on the environment. (HS- ESS3-1)
- Plan and carry out investigations to compare and contrast current solutions for waste management, such as septic systems vs wastewater treatment plants, and determine the solutions that are the most stable or cause change to the environment. (HS-ESS3-4)
- Engage in argument from evidence how people who live in close proximity to incineration plants can inhale the chemicals released and cause developmental problems for those who consume it. (HS-ESS3-6)

Summative assessments:

Do-Nows
Exit Tickets
Question and answer/reflections
Group/individual discussion
End of chapter Quiz
End of Unit Test
One Project 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):

Deepl.com (English to Spanish)
Teacher created hands on activities.
Student resources on Google classroom.
Khan Academy
You tube videos
Lab manuals

TECHNOLOGY RESOURCES:

Individual student Chromebook
Smart Board
Online resources

Prepared by: Nabaneeta Mukherjee

Approved by the AUL Board of Trustees on: _____