CURRICULUM

FOR

ADVANCED PLACEMENT ENVIRONMENTAL SCIENCE

GRADES 11-12

This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.

ACKNOWLEDGMENTS

Dr. Susan Dube, Program Supervisor of Science/Technology Education

The Board acknowledges the following who contributed to the preparation of this curriculum.

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Subject/Course Title:
Advanced Placement Environmental Science
Grades 11-12

Date of Board Adoptions:
September 17, 2019

ACCOMMODATIONS

504 Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Provide extra visual and verbal cues and prompts.
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages).
- Provide study sheets and teacher outlines prior to assessments.
- Quiet corner or room to calm down and relax when anxious.
- Reduction of distractions.
- Permit answers to be dictated.
- Hands-on activities.
- Use of manipulatives.
- Assign preferential seating.
- No penalty for spelling errors or sloppy handwriting.
- Follow a routine/schedule.
- Provide student with rest breaks.
- Use verbal and visual cues regarding directions and staying on task.
- Assist in maintaining agenda book.

IEP Accommodations:

- Provide scaffolded vocabulary and vocabulary lists.
- Differentiate reading levels of texts (e.g., Newsela).
- Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials.
- Provide extra visual and verbal cues and prompts.
- Provide links to audio files and utilize video clips.
- Provide graphic organizers and/or checklists.
- Provide modified rubrics.
- Provide a copy of teaching notes, especially any key terms, in advance.
- Provide students with additional information to supplement notes.
- Modify questioning techniques and provide a reduced number of questions or items on tests.
- Allow additional time to complete assignments and/or assessments.
- Provide shorter writing assignments.
- Provide sentence starters.
- Utilize small group instruction.
- Utilize Think-Pair-Share structure.
- Check for understanding frequently.
- Have student restate information.
- Support auditory presentations with visuals.
- Provide study sheets and teacher outlines prior to assessments.
- Use of manipulatives.
- Have students work with partners or in groups for reading, presentations, assignments, and analyses.
- Assign appropriate roles in collaborative work.
- Assign preferential seating.
- Follow a routine/schedule.

Gifted and Talented Accommodations:

- Differentiate reading levels of texts (e.g., Newsela).
- Offer students additional texts with higher lexile levels.
- Provide more challenging and/or more supplemental readings and/or activities to deepen understanding.
- Allow for independent reading, research, and projects.
- Accelerate or compact the curriculum.
- Offer higher-level thinking questions for deeper analysis.
- Offer more rigorous materials/tasks/prompts.
- Increase number and complexity of sources.
- Assign group research and presentations to teach the class.
- Assign/allow for leadership roles during collaborative work and in other learning activities.

ELL Accommodations:

- Provide extended time.
- Assign preferential seating.
- Assign peer buddy who the student can work with.
- Check for understanding frequently.
- Provide language feedback often (such as grammar errors, tenses, subject-verb agreements, etc…).
- Have student repeat directions.
- Make vocabulary words available during classwork and exams.
- Use study guides/checklists to organize information.
- Repeat directions.
- Increase one-on-one conferencing.
- Allow student to listen to an audio version of the text.
- Give directions in small, distinct steps.
- Allow copying from paper/book.
- Give student a copy of the class notes.
- Provide written and oral instructions.
- Differentiate reading levels of texts (e.g., Newsela).
- Shorten assignments.
- Read directions aloud to student.
- Give oral clues or prompts.
- Record or type assignments.

	• Adapt worksheets/packets. • Create alternate assignments. • Have student enter written assignments in criterion, where they can use the planning maps to help get them started and receive feedback after it is submitted. • Allow student to resubmit assignments. • Use small group instruction. • Simplify language. • Provide scaffolded vocabulary and vocabulary lists. • Demonstrate concepts possibly through the use of visuals. • Use manipulatives. • Emphasize critical information by highlighting it for the student. • Use graphic organizers. • Pre-teach or pre-view vocabulary. • Provide student with a list of prompts or sentence starters that they can use when completing a written assignment. • Provide audio versions of the textbooks. • Highlight textbooks/study guides. • Use supplementary materials. • Give assistance in note taking • Use adapted/modified textbooks. • Allow use of computer/word processor. • Allow student to answer orally, give extended time (time-and-a-half). • Allow tests to be given in a separate location (with the ESL teacher). • Allow additional time to complete assignments and/or assessments. • Read question to student to clarify. • Provide a definition or synonym for words on a test that do not impact the validity of the exam. • Modify the format of assessments. • Shorten test length or require only selected test items. • Create alternative assessments. • On an exam other than a spelling test, don’t take points off for spelling errors.

RAHWAY PUBLIC SCHOOLS CURRICULUM

Advanced Placement Environmental Science – Grades 10-12

PACING GUIDE

Unit	Title	Pacing
1	Ecosystems	3 weeks
2	Biodiversity	2.5 weeks
3	Populations	4 weeks
4	Earth Systems & Resources	2.5 weeks
5	Land & Water Use	4 weeks
6	Energy Resources & Consumption	3.5 weeks
7	Atmospheric Pollution	2.5 weeks
8	Aquatic & Terrestrial Pollution	4 weeks
9	Global Change	4 weeks
10	Post AP Exam	10 weeks

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT ONE – The Living World: Ecosystems

Content Area: Advanced Placement Environmental Science

Unit Title: The Living World: Ecosystems

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will form the foundation for the course by examining the Earth as a system with interdependent components, processes, and relationships. Students will examine the distribution of resources in ecosystems and its influences on species interactions. This distribution is dynamic, and it has changed due to global climate change.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-PS1-7.** Use mathematical representations to support the claim that atoms, and therefore mass, are conserve during a chemical reaction.
- **HS-PS3-1.** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known
- **HS-LS1-6.** Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- **HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
- **HS-LS2-5.** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
- **HS-ESS2-3.** Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- **HS-ESS2-6.** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.1** Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- **9.3.ST-SM.4** Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.

Interdisciplinary Connections and Standards:

- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **TECH.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.
- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.R8.** Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- **NJSLSA.R9.** Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

Unit Understanding

Students will understand that…

- availability of resources influences species interactions.
- global distribution and principal environmental aspects of terrestrial biomes.
- explanation of the steps and reservoir interactions in the carbon cycle.
- explanation of the steps and reservoir interactions in the nitrogen cycle.
- explanation of the steps and reservoir interactions in the phosphorus cycle.
- explanation of the steps and reservoir interactions in the hydrologic cycle.
- solar energy is acquired and transferred by living organisms.
- energy flows and matter cycles through trophic levels.
- energy decreases as it flows through ecosystems.
- food chains and food webs, and their constituent members by trophic level.

Unit Essential Questions:

- How does energy change forms?
- How old is the water you drink?

Knowledge and Skills:

Students will know...

- In a predator-prey relationship, the predator is an organism that eats another organism (the prey).
- Symbiosis is a close and long-term interaction between two species in an ecosystem. Types of symbiosis include mutualism, commensalism, and parasitism.
- Competition can occur within or between species in an ecosystem where there are limited resources. Resource partitioning— using the resources in different ways, places, or at different times—can reduce the negative impact of competition on survival.
- A biome contains characteristic communities of plants and animals that result from, and are adapted to, its climate.
- Major terrestrial biomes include taiga, temperate rainforests, temperate seasonal forests, tropical rainforests, shrubland, temperate grassland, savanna, desert, and tundra.
- The global distribution of non-mineral terrestrial natural resources, such as water and trees for lumber, varies because of some combination of climate, geography, latitude and altitude, nutrient availability, and soil.
- The worldwide distribution of biomes is dynamic; the distribution has changed in the past and may again shift as a result of global climate changes.

- Freshwater biomes include streams, rivers, *wetlands, ponds, and lakes. These freshwater biomes are a vital resource for drinking water.
- Marine biomes include oceans, coral reefs, marshland, and estuaries. Algae in marine biomes supply a large portion of the Earth's oxygen, and also take in carbon dioxide from the atmosphere.
- The global distribution of non-mineral marine natural resources, such as different types of fish, varies because of some combination of salinity, depth, turbidity, nutrient availability, and temperature.
- The carbon cycle is the movement of atoms and molecules containing the element carbon between sources and sinks.
- Some of the reservoirs in which carbon compounds occur in the carbon cycle hold those compounds for long periods of time, while some hold them for relatively short periods of time.
- Carbon cycles between photosynthesis and cellular respiration in living things.
- Plant and animal decomposition have led to the storage of carbon over millions of
- The nitrogen cycle is the movement of atoms and molecules containing the element nitrogen between sources and sinks.
- The burning of fossil fuels quickly moves that stored carbon into atmospheric carbon, in the form of carbon dioxide.
- Most of the reservoirs in which nitrogen compounds occur in the nitrogen cycle hold those compounds for relatively short periods of time.
- Nitrogen fixation is the process in which atmospheric nitrogen is converted into a form of nitrogen (primarily ammonia) that is available for uptake by plants and that can be synthesized into plant tissue.
- The atmosphere is the major reservoir of nitrogen.
- The phosphorus cycle is the movement of atoms and molecules containing the element phosphorus between sources and sinks.
- The major reservoirs of phosphorus in the phosphorus cycle are rock and sediments that contain phosphorus-bearing minerals.
- There is no atmospheric component in the phosphorus cycle, and the limitations this imposes on the return of phosphorus from the ocean to land make phosphorus naturally scarce in aquatic and many terrestrial ecosystems. In undisturbed ecosystems, phosphorus is the limiting factor in biological systems.
- The hydrologic cycle, which is powered by the sun, is the movement of water in its various solid, liquid, and gaseous phases between sources and sinks.
- The oceans are the primary reservoir of water at the Earth's surface, with ice caps and groundwater acting as much smaller reservoirs.
- Primary productivity is the rate at which solar energy (sunlight) is converted into organic compounds via photosynthesis over a unit of time.
- Gross primary productivity is the total rate of photosynthesis in a given area.
- Net primary productivity is the rate of energy storage by photosynthesizers in a given area, after subtracting the energy lost to respiration.
- Productivity is measured in units of energy per unit area per unit time (e.g., kcal/m2/yr).
- Most red light is absorbed in the upper 1m of water, and blue light only penetrates deeper than 100m in the clearest water. This affects photosynthesis in aquatic ecosystems, whose photosynthesizers have adapted mechanisms to address the lack of visible light.
- All ecosystems depend on a continuous inflow of high-quality energy in order to maintain their structure and function of transferring matter between the environment and organisms via biogeochemical cycles.
- Biogeochemical cycles are essential for life and each cycle demonstrates the conservation of matter.
- In terrestrial and near-surface marine communities, energy flows from the sun to producers in the lowest trophic levels and then upward to higher trophic levels.
- The 10% rule approximates that in the transfer of energy from one trophic level to the next, only about 10% of the energy is passed on.
- The loss of energy that occurs when energy moves from lower to higher trophic levels can be explained through the laws of thermodynamics.

- A food web is a model of an interlocking pattern of food chains that depicts the flow of energy and nutrients in two or more food chains.
- Positive and negative feedback loops can each play a role in food webs. When one species is removed from or added to a specific food web, the rest of the food web can be affected

Students will be able to…

- Describe environmental concepts and processes.
- Explain environmental concepts and processes.
- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: In theoretical contexts and in applied contexts.
- Calculate an accurate numeric answer with appropriate units.
- Describe characteristics of an environmental concept, process, or model represented visually

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will explain environmental processes, how energy changes form.
  - Students will explain the relationships between environmental concepts, processes, and models in theoretical and applied contexts.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Summer Packet
- Net Primary Productivity lab
- Owl Pellet Dissection Energy lab
- Nitrogen cycle game
- Carbon cycle model game
- Personal biome research project
- Biome post cards
- Biome speed dating

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebooks

UNIT TWO – The Living World: Biodiversity

Content Area: Advanced Placement Environmental Science

Unit Title: The Living World: Biodiversity

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine the concept that biodiversity in ecosystems is a key component to sustaining life within the living world. Natural and human distributions have short and long term impacts on ecosystems. Organisms within ecosystems must adapt to the changes created by these disruptions.

Approximate Length of Unit: 2.5 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- **HS-LS2-8.** Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.
- **HS-LS4-6.** Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*
- **HS-LS3-1.** Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
- **HS-LS3-2.** Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
- **HS-LS3-3.** Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

21^{st} Century Life and Career Skills:

- **9.3.ST-SM.4** Apply critical thinking skills to review information, explain statistical analysis, and to translate, interpret and summarize research and statistical data.
- **9.3.12.AG-ENV.**1 Use analytical procedures and instruments to manage environmental service systems. 9.3.12.AG-ENV.2 Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

Interdisciplinary Connections and Standards:

- **TECH.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.
- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.

- **TECH.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.
- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.R8.** Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- **NJSLSA.R9.** Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Unit Understanding

Students will understand that…

- levels of biodiversity and their importance to ecosystems.
- ecosystem services that are beneficial to humans
- results of human disruptions to ecosystem services.
- cause and effects of island biogeography.
- role of island biogeography in evolution.
- roles of ecological tolerance affect survival.
- natural disruptions, both short and long-term, impact an ecosystem.
- organisms adapt to their environment.
- ecological succession is a process.
- effect of ecological succession on ecosystems.

Unit Essential Questions:

- Can an invasive species be considered a native species if it occupies a place for a long time?

Knowledge and Skills:

Students will know...

- Biodiversity in an ecosystem includes genetic, species, and habitat diversity.
- The more genetically diverse a population is, the better it can respond to environmental stressors. Additionally, a population bottleneck can lead to a loss of genetic diversity.
- Ecosystems that have a larger number of species are more likely to recover from disruptions.
- Loss of habitat leads to a loss of specialist species, followed by a loss of generalist species. It also leads to reduced numbers of species that have large territorial requirements.
- Species richness refers to the number of different species found in an ecosystem.
- There are four categories of ecosystem services: provisioning, regulating, cultural, and supporting.
- Anthropogenic activities can disrupt ecosystem services, potentially resulting in economic and ecological consequences.
- Island biogeography is the study of the ecological relationships and distribution of organisms on islands, and of these organisms' community structures.
- Islands have been colonized in the past by new species arriving from elsewhere.
- Many island species have evolved to be specialists versus generalists because of the limited resources, such as food and territory, on most islands. The long-term survival of specialists may be jeopardized if and when invasive species, typically generalists, are introduced and outcompete the specialists.

- Ecological tolerance refers to the range of conditions, such as temperature, salinity, flow rate, and sunlight that an organism can endure before injury or death results.
- Ecological tolerance can apply to individuals and to species.
- Natural disruptions to ecosystems have environmental consequences that may, for a given occurrence, be as great as, or greater than, many human-made disruptions.
- Earth system processes operate on a range of scales in terms of time. Processes can be periodic, episodic, or random.
- Earth's climate has changed over geological time for many reasons.
- Sea level has varied significantly as a result of changes in the amount of glacial ice on Earth over geological time.
- Major environmental change or upheaval commonly results in large swathes of habitat changes.
- Wildlife engages in both short- and long-term migration for a variety of reasons, including natural disruptions.
- Organisms adapt to their environment over time, both in short- and long-term scales, via incremental changes at the genetic level.
- Environmental changes, either sudden or gradual, may threaten a species' survival, requiring individuals to alter behaviors, move, or perish.
- There are two main types of ecological succession: primary and secondary succession.
- A keystone species in an ecosystem is a species whose activities have a particularly significant role in determining community structure.
- An indicator species is a plant or animal that, by its presence, abundance, scarcity, or chemical composition, demonstrates that some distinctive aspect of the character or quality of an ecosystem is present.
- Pioneer members of an early successional species commonly move into unoccupied habitat and over time adapt to its particular conditions, which may result in the origin of new species.
- Succession in a disturbed ecosystem will affect the total biomass, species richness, and net productivity over time.

Students will be able to…

- Describe environmental concepts and processes.
- Explain environmental concepts and processes.
- Identify the author's claim.
- Describe patterns or trends in data.
- Describe relationships among variables in data represented.
- Explain patterns and trends in data to draw conclusions. .

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will explain whether an invasive species that occupies a space for a long period of time can be considered a native species.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- School parking lot biodiversity Shannon-Weiner Index
- Milton lake biodiversity trip
- Carolina Biodiversity for AP Environmental science

- Succession game
- M&M Evolution of bugs over time model

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources
- Carolina Biodiversity for AP Environmental science kit
- Water quality test kit/sensors
- Kick-nets and boots

Equipment & Materials:

- Projector
- Chromebooks

UNIT THREE – Populations

Content Area: Advanced Placement Environmental Science

Unit Title: Populations

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine how populations within ecosystems change over time in response to a variety of factors. There is a relationship between the type of species and the changes in habitat over time. Population growth is limited to environmental factors.

Approximate Length of Unit: 4 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-LS2-1.** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
- **HS-LS2-2.** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- **HS-LS2-6.** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- **9.3.12.AG-ENV.2** Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

Interdisciplinary Connections and Standards:

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **SOC.6.2.12.B.6.a** Determine the global impact of increased population growth, migration, and changes in urban-rural populations on natural resources and land use.
- **SOC. 6.2.12.C.6.b** Compare and contrast demographic trends in industrialized and developing nations, and evaluate the potential impact of these trends on the economy, political stability, and use of resources.
- **TECH.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.
- **TECH.8.2.12.B.4** Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.

- **TECH.8.2.12.D.4** Assess the impacts of emerging technologies on developing countries.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Unit Understanding

Students will understand that…

- impacts of differences between generalist and specialist species.
- impacts of differences between K- and r-selected species.
- use of survivorship curves.
  impacts of populations that exceed carrying capacity.
- resource availability affects population growth.
- predictions can be made with age structure diagrams.
- factors that affect total fertility rate in human populations.
- human populations experience growth and decline.
- demographic transition is a process of the human population.

Unit Essential Questions:

- How do changes in habitats influence changes in species over time?
- How is educational opportunity for women connected to human population changes?

Knowledge and Skills:

Students will know...

- Specialist species tend to be advantaged in habitats that remain constant, while generalist species tend to be advantaged in habitats that are changing.
- K-selected species tend to be large, have few offspring per reproduction event, live in stable environments, expend significant energy for each offspring, mature after many years of extended youth and parental care, have long life spans/life expectancy, and reproduce more than once in their lifetime. Competition for resources in K-selected species' habitats is usually relatively high.
- r-selected species tend to be small, have many offspring, expend or invest minimal energy for each offspring, mature early, have short life spans, and may reproduce only once in their lifetime. Competition for resources in r-selected species' habitats is typically relatively low.
- Biotic potential refers to the maximum reproductive rate of a population in ideal conditions.
- Many species have reproductive strategies that are not uniquely r-selected or K-selected, or they change in different conditions at different times.
- K-selected species are typically more adversely affected by invasive species than r-selected species, which are minimally affected by invasive species. Most invasive species are r-selected species.
- A survivorship curve is a line that displays the relative survival rates of a cohort—a group of individuals of the same age—in a population, from birth to the maximum age reached by any one cohort member. There are Type I, Type II, and Type III curves.
- Survivorship curves differ for K-selected and r-selected species, with K-selected species typically following a Type I or Type II curve and r-selected species following a Type III curve.
- When a population exceeds its carrying capacity (carrying capacity can be denoted as K), overshoot occurs. There are environmental impacts of population overshoot, including resource depletion.
- A major ecological effect of population overshoot is dieback of the population (often severe to catastrophic) because the lack of available resources leads to famine, disease, and/or conflict.
- Population growth is limited by environmental factors, especially by the available resources and space.
- Resource availability and the total resource base are limited and finite over all scales of time.

- When the resources needed by a population for growth are abundant, population growth usually accelerates.
- When the resource base of a population shrinks, the increased potential for unequal distribution of resources will ultimately result in increased mortality, decreased fecundity, or both, resulting in population growth declining to, or below, carrying capacity.
- Population growth rates can be interpreted from age structure diagrams by the shape of the structure.
- A rapidly growing population will, as a rule, have a higher proportion of younger people compared to stable or declining populations.
- Total fertility rate (TFR) is affected by the age at which females have their first child, educational opportunities for females, access to family planning, and government acts and policies.
- If fertility rate is at replacement levels, a population is considered relatively stable.
- Factors associated with infant mortality rates include whether mothers have access to good healthcare and nutrition. Changes in these factors can lead to changes in infant mortality rates over time.
- Birth rates, infant mortality rates, and overall death rates, access to family planning, access to good nutrition, access to education, and postponement of marriage all affect whether a human population is growing or declining.
- Factors limiting global human population include the Earth's carrying capacity and the basic factors that limit human population growth as set forth by Malthusian theory.
- Population growth can be affected by both density-independent factors, such as major storms, fires, heat waves, or droughts, and density-dependent factors, such as access to clean water and air, food availability, disease transmission, or territory size.
- The rule of 70 states that dividing the number 70 by the percentage population growth rate approximates the population's doubling time.
- The demographic transition refers to the transition from high to lower birth and death rates in a country or region as development occurs and that country moves from a preindustrial to an industrialized economic system. This transition is typically demonstrated through a four-stage demographic transition model (DTM).
- Characteristics of developing countries include higher infant mortality rates and more children in the workforce than developed countries.

Students will be able to…

- Explain environmental concepts and processes.
- Describe patterns or trends in data.
- Explain patterns and trends in data to draw conclusions.
- Explain what the data implies or illustrates about environmental issues.
- Apply appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis).
- Describe environmental problems.
- Explain environmental concepts, processes, or models in applied contexts.

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EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will how changes in habitats influence changes in species over time.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Predator-Prey model with beans
- Human Demographic research and presentation
- Obituary/graveyard data collects and analysis lab
- Power of the Pyramids-Age structure pyramids

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebook

UNIT FOUR – Earth Systems and Resources

Content Area: Advanced Placement Environmental Science

Unit Title: Earth Systems and Resources

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine how earth systems and resources support life. Changes in earths systems will result in the creation of major geological formations and different soil types. Students will explore the movement of air and water.

Approximate Length of Unit: 2.5 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **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.
- **HS-ESS1-6.** Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
- **HS-ESS2-1.** Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- **HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **HS-ESS3-2.** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **HS-ESS3-3.** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **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.

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.1** Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- **9.3.12.AG-ENV.2** Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

Interdisciplinary Connections and Standards:

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

- **SOC. 6.2.12.C.6.b** Compare and contrast demographic trends in industrialized and developing nations, and evaluate the potential impact of these trends on the economy, political stability, and use of resources.
- **TECH.8.1.12.F.1** Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
- **TECH.8.2.12.A.2** Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
- **TECH.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.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Unit Understanding

Students will understand that…

- geological changes and events that occur at convergent, divergent, and transform plate boundaries.
- the variation within the characteristics and formation of soil.
- similarities and differences between properties of different soil types.
- factors make up the structure and composition of the Earth's atmosphere.
- environmental factors can result in atmospheric circulation.
- Importance of characteristics of a watershed.
- the sun's energy affects the Earth's surface.
- the Earth's geography affects weather and climate.
- the environmental changes and effects that result from El Niño or La Niña events (El Niño–Southern Oscillation).

Unit Essential Questions:

- How does energy from the sun influence the weather?
- How can earthquakes be predicted?

Knowledge and Skills:

Students will know...

- Convergent boundaries can result in the creation of mountains, island arcs, earthquakes, and volcanoes
- Divergent boundaries can result in seafloor spreading, rift valleys, volcanoes, and earthquakes.
- Transform boundaries can result in earthquakes.
- Maps that show the global distribution of plate boundaries can be used to determine the location of volcanoes, island arcs, earthquakes, hot spots, and faults.
- An earthquake occurs when stress overcomes a locked fault, releasing stored energy.
- Soils are formed when parent material is weathered, transported, and deposited.
- Soils are generally categorized by horizons based on their composition and organic material.
- Soils can be eroded by winds or water. Protecting soils can protect water quality as soils effectively filter and clean water that moves through them.
- Water holding capacity—the total amount of water soil can hold—varies with different soil types. Water retention contributes to land productivity and fertility of soils.
- The particle size and composition of each soil horizon can affect the porosity, permeability, and fertility of the soil.

- There are a variety of methods to test the chemical, physical, and biological properties of soil that can aid in a variety of decisions, such as irrigation and fertilizer requirements.
- A soil texture triangle is a diagram that allows for the identification and comparison of soil types based on their percentage of clay, silt, and sand.
- The atmosphere is made up of major gases, each with its own relative abundance.
- The layers of the atmosphere are based on temperature gradients and include the troposphere, stratosphere, mesosphere, thermosphere, and exosphere.
- Global wind patterns primarily result from the most intense solar radiation arriving at the equator, resulting in density differences and the Coriolis effect.
- Characteristics of a given watershed include its area, length, slope, soil, vegetation types, and divides with adjoining watersheds.
- Incoming solar radiation (insolation) is the Earth's main source of energy and is dependent on season and latitude.
- The angle of the sun's rays determines the intensity of the solar radiation. Due to the shape of the Earth, the latitude that is directly horizontal to the solar radiation receives the most intensity.
- The highest solar radiation per unit area is received at the equator and decreases toward the poles.
- The solar radiation received at a location on the Earth's surface varies seasonally, with the most radiation received during the location's longest summer day and the least on the shortest winter day.
- The tilt of Earth's axis of rotation causes the Earth's seasons and the number of hours of daylight in a particular location on the Earth's surface.
- Weather and climate are affected not only by the sun's energy but by geologic and geographic factors, such as mountains and ocean temperature.
- A rain shadow is a region of land that has become drier because a higher elevation area blocks precipitation from reaching the land.
- El Niño and La Niña are phenomena associated with changing ocean surface temperatures in the Pacific Ocean. These phenomena can cause global changes to rainfall, wind, and ocean circulation patterns.
- El Niño and La Niña are influenced by geological and geographic factors and can affect different locations in different ways.

Students will be able to…

- Explain how environmental concepts and processes represented visually relate to broader environmental issues.
- Identify a research method, design, and/or measure used.
- Describe an aspect of a research method, design, and/or measure used.
- Describe characteristics of an environmental concept, process, or model represented visually.
- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: in theoretical contexts and in applied contexts.
- Explain environmental concepts, processes, or models in applied contexts.
- Describe environmental problems.

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will describe environmental problems in different contexts.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Watershed paper model and lab

- Rock cycle interactive
- Oreo tectonics
- Earthquakes, Volcanoes and Plate Tectonics model
- Carolina Soil Productivity lab
- Edible soil lab
- Coriolis Effect simulation
- El Nino modeling activity

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources
- Carolina Soil Productivity lab kit
- Flinn Earthquakes, Volcanoes and Plate Tectonics model kit

Equipment & Materials:

- Projector
- Chromebooks

UNIT FIVE – Land and Water Use

Content Area: Advanced Placement Environmental Science

Unit Title: Land and Water Use

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine how human activities that disrupt ecosystems both positively and negatively and the methods employed to reduce impact. It examines human use of natural resources through many means, including mining and clearcutting, and the impacts on the environment. There is a large focus on the impact of agriculture.

Approximate Length of Unit: 4 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **HS-ESS3-2.** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **HS-ESS3-3.** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS3-4.** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **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.

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.1** Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- **9.3.12.AG-PL.1** Develop and implement a crop management plan for a given production goal that accounts for environmental factors.
- **9.3.12.AG-ENV.1** Use analytical procedures and instruments to manage environmental service systems.
- **9.3.12.AG-ENV.2** Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- **9.3.12.AG-FD.4** Explain the scope of the food industry and the historical and current developments of food products and processing.

Interdisciplinary Connections and Standards:

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

- **MA.N-Q.A.2** - Define appropriate quantities for the purpose of descriptive modeling.
- **SOC. 6.2.12.C.6.b** Compare and contrast demographic trends in industrialized and developing nations, and evaluate the potential impact of these trends on the economy, political stability, and use of resources.
- **TECH.8.2.12.A.2** Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
- **TECH.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.
- **TECH.8.2.12.B.4** Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Unit Understanding

Students will understand that…

- impact and concept of the tragedy of the commons.
- the effect of clearcutting on forests
- cost and benefits of changes in agricultural practices.
- agricultural practices that cause environmental damage.
- different methods of irrigation.
- benefits and drawbacks of different methods of irrigation.
- benefits and drawbacks of different methods of pest control
- different methods of meat production.
- benefits and drawbacks of different methods of meat production.
- causes of and problems related to overfishing.
- types of natural resource extraction through mining.
- ecological and economic impacts of natural resource extraction through mining.
- effects of urbanization on the environment.
- variables measured in an ecological footprint.
- importance of concept of sustainability.
- methods for mitigating problems related to urban runoff.
- process of integrated pest management (IPM).
- benefits and drawbacks of integrated pest management (IPM).
- process of sustainable agricultural and food production practices.
- benefits and drawbacks of aquaculture.
- methods for mitigating human impact on forests

Unit Essential Questions:

- How does your use of natural resources impact the world?
- Why are sustainable practices difficult to implement?

Knowledge and Skills:

Students will know...

- The tragedy of the commons suggests that individuals will use shared resources in their own self-interest rather than in keeping with the common good, thereby depleting the resources.

- Clearcutting can be economically advantageous but leads to soil erosion, increased soil and stream temperatures, and flooding.
- Forests contain trees that absorb pollutants and store carbon dioxide. The cutting and burning of trees releases carbon dioxide and contributes to climate change.
- The Green Revolution started a shift to new agricultural strategies and practices in order to increase food production, with both positive and negative results. Some of these strategies and methods are mechanization, genetically modified organisms (GMOs), fertilization, irrigation, and the use of pesticides.
- Mechanization of farming can increase profits and efficiency for farms. It can also increase reliance on fossil fuels.
- Agricultural practices that can cause environmental damage include tilling, slashand-burn farming, and the use of fertilizers.
- The largest human use of freshwater is for irrigation (70%).
- Types of irrigation include drip irrigation, flood irrigation, furrow irrigation, drip irrigation, and spray irrigation.
- Waterlogging occurs when too much water is left to sit in the soil, which raises the water table of groundwater and inhibits plants' ability to absorb oxygen through their roots.
- Furrow irrigation involves cutting furrows between crop rows and filling them with water. This system is inexpensive, but about 1/3 of the water is lost to evaporation and runoff.
- Flood irrigation involves flooding an agricultural field with water. This system sees about 20% of the water lost to evaporation and runoff. This can also lead to waterlogging of the soil.
- Spray irrigation involves pumping ground water into spray nozzles across an agricultural field. This system is more efficient than flood and furrow irrigation, with only 1/4 or less of the water lost to evaporation or runoff. However, spray systems are more expensive than flood and furrow irrigation, and also requires energy to run.
- Drip irrigation uses perforated hoses to release small amounts of water to plant roots. This system is the most efficient, with only about 5% of water lost to evaporation and runoff. However, this system is expensive and so is not often used.
- Salinization occurs when the salts in groundwater remain in the soil after the water evaporates. Over time, salinization can make soil toxic to plants.
- Aquifers can be severely depleted if overused for agricultural irrigation, as has happened to the Ogallala Aquifer in the central United States.
- One consequence of using common pest-control methods such as pesticides, herbicides, fungicides, rodenticides, and insecticides is that organisms can become resistant to them through artificial selection. Pest control decreases crop damage by pest and increases crop yields.
- Crops can be genetically engineered to increase their resistance to pests and diseases. However, using genetically engineered crops in planting or other ways can lead to loss of genetic diversity of that particular crop.
- Methods of meat production include concentrated animal feeding operations (CAFOs), also called feedlots, and free-range grazing.
- Meat production is less efficient than agriculture; it takes approximately 20 times more land to produce the same amount of calories from meat as from plants.
- Concentrated animal feeding operation (CAFOs) are used as a way to quickly get livestock ready for slaughter. They tend to be crowded, and animals are fed grains or feed that are not as suitable as grass. Additionally, feedlots generate a large amount of organic waste, which can contaminate ground and surface water. The use of feedlots are less expensive than other methods, which can keep costs to consumers down.
- Free range grazing allows animals to graze on grass during their entire lifecycle. Meat from free range animals tends to be free from antibiotics and other chemicals used in feedlots. Organic waste from these animals acts as fertilizer. Free range grazing requires large areas of land and the meat produced is more expensive for consumers.
- Overgrazing occurs when too many animals feed on a particular area of land. Overgrazing causes loss of vegetation, which leads to soil erosion.

- Overgrazing can cause desertification. Desertification is the degradation of low precipitation regions toward being increasingly arid until they become deserts.
- Less consumption of meat could reduce CO_2, methane, and N_2O emissions; conserve water; reduce the use of antibiotics and growth hormones; and improve topsoil.
- Overfishing has led to the extreme scarcity of some fish species, which can lessen biodiversity in aquatic systems and harm people who depend on fishing for food and commerce.
- As the more accessible ores are mined to depletion, mining operations are forced to access lower grade ores. Accessing these ores requires increased use of resources that can cause increased waste and pollution.
- Surface mining is the removal of large portions of soil and rock, called overburden, in order to access the ore underneath. An example is strip mining, which removes the vegetation from an area, making the area more susceptible to erosion.
- Mining wastes include the soil and rocks that are moved to gain access to the ore and the waste, called slag and tailings that remain when the minerals have been removed from the ore. Mining helps to provide low cost energy and material necessary to make products. The mining of coal can destroy habitats, contaminate ground water, and release dust particles and methane.
- As coal reserves get smaller, due to a lack of easily accessible reserves, it becomes necessary to access coal through subsurface mining, which is very expensive.
- Urbanization can lead to depletion of resources and saltwater intrusion in the hydrologic cycle.
- Urbanization, through the burning of fossil fuels and landfills, affects the carbon cycle by increasing the amount of carbon dioxide in the atmosphere.
- Impervious surfaces are human-made structures—such as roads, buildings, sidewalks, and parking lots—that do not allow water to reach the soil, leading to flooding.
- Urban sprawl is the change in population distribution from high population density areas to low density suburbs that spread into rural lands, leading to potential environmental problems.
- Ecological footprints compare resource demands and waste production required for an individual or a society.
- Sustainability refers to humans living on Earth and their use of resources without depletion of the resources for future generations. Environmental indicators that can guide humans to sustainability include biological diversity, food production, average global surface temperatures and CO_2 concentration s, human population, and resource depletion.
- Sustainable yield is the amount of a renewable resource that can be taken without reducing the available supply.
- Methods to increase water infiltration include replacing traditional pavement with permeable pavement, planting trees, increased use of public transportation, and building up, not out.
- Integrated pest management (IPM) is a combination of methods used to effectively control pest species while minimizing the disruption to the environment. These methods include biological, physical, and limited chemical methods such as biocontrol, intercropping, crop rotation, and natural predators of the pests.
- The use of integrated pest management (IPM) reduces the risk that pesticides pose to wildlife, water supplies, and human health.
- Integrated pest management (IPM) minimizes disruptions to the environment and threats to human health but can be complex and expensive.
- The goal of soil conservation is to prevent soil erosion. Different methods of soil conservation include contour plowing, windbreaks, perennial crops, terracing, no-till agriculture, and strip cropping.
- Strategies to improve soil fertility include crop rotation and the addition of green manure and limestone.
- Rotational grazing is the regular rotation of livestock between different pastures in order to avoid overgrazing in a particular area.
- Aquaculture has expanded because it is highly efficient, requires only small areas of water, and requires little fuel.
- Aquaculture can contaminate wastewater, and fish that escape may compete or breed with wild fish. The density of fish in aquaculture can lead to increases in disease incidences, which can be transmitted to wild fish.

- Some of the methods for mitigating deforestation include reforestation, using and buying wood harvested by ecologically sustainable forestry techniques, and reusing wood.
- Methods to protect forests from pathogens and insects include integrated pest management (IPM) and the removal of affected trees.
- Prescribed burn is a method by which forests are set on fire under controlled conditions in order to reduce the occurrence of natural fires.

Students will be able to…

- Explain how environmental concepts and processes.
- Describe environmental concepts and processes.
- Describe the author's perspective and assumptions.
- Describe disadvantages, advantages, or unintended consequences for potential solutions
- Make a claim that proposes a solution to an environmental problem in an applied context.
- Explain what the data implies or illustrates about environmental issues.
- Describe potential responses or approaches to environmental problems.
- Identify a research method, design, and/or measure used.
- Use data and evidence to support a potential solution.
- Justify a proposed solution, by explaining potential advantages.

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will explain why sustainable practices are difficult to implement.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Ecological footprint
- Aquifer model
- GMO debate
- Farm field trip
- Tragedy of Commons goldfish cracker lab
- Water Usage research project
- Cookie mining lab
- Lego Urbanization City Planning
- Food Inc. Movie

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebooks

UNIT SIX – Energy Resources and Consumption

Content Area: Advanced Placement Environmental Science

Unit Title: Energy Resources and Consumption

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine how human use of renewable and nonrenewable sources of energy and its impact on the environment. Energy consumption differs throughout the world and the availability of natural energy resources depends on the region's geologic history.

Approximate Length of Unit: 3.5 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-ESS3-1** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity
- **HS-ESS3-2** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **HS-ESS3-3** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- **HS-ESS2-6** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- **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.
- **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-PS3-2** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
- **HS-PS3-3** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.1** Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- 9.3.12.AG-**NR.3** Develop plans to ensure sustainable production and processing of natural resources.
- **9.3.12.AG-ENV.2** Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

- **9.3.12.AG-ENV.4** Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).

Interdisciplinary Connections and Standards:

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **MA.N-Q.A.2** - Define appropriate quantities for the purpose of descriptive modeling.
- **SOC. 6.2.12.C.6.b** Compare and contrast demographic trends in industrialized and developing nations, and evaluate the potential impact of these trends on the economy, political stability, and use of resources.
- **TECH.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.
- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **TECH.8.1.12.F.1** Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
- **TECH.8.2.12.D.4** Assess the impacts of emerging technologies on developing countries.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Unit Understanding

Students will understand that…

- differences between nonrenewable and renewable energy sources.
- trends in energy consumption.
- types of fuels and their uses.
- location of where natural energy resources occur.
- the use and methods of fossil fuels in power generation.
- effects of fossil fuels on the environment.
- use of nuclear energy in power generation.
- effects of the use of nuclear energy on the environment.
- effects of the use of biomass in power generation on the environment.
- use of solar energy in power generation.
- effects of the use of solar energy in power generation on the environment
- use of hydroelectricity in power generation.
- effects of the use of hydroelectricity in power generation on the environment.
- use of geothermal energy in power generation.
- effects of the use of geothermal energy in power generation on the environment.
- use of hydrogen fuel cells in power generation.
- effects of the use of hydrogen fuel cells in power generation on the environment.
- use of wind energy in power generation.
- effects of the use of wind energy in power generation on the environment.
- methods for conserving energy

Unit Essential Questions:

- Why are fossil fuels the most widely used energy resources if they are nonrenewable?

Knowledge and Skills:

Students will know...

- Nonrenewable energy sources are those that exist in a fixed amount and involve energy transformation that cannot be easily replaced.
- Renewable energy sources are those that can be replenished naturally, at or near the rate of consumption, and reused.
- The use of energy resources is not evenly distributed between developed and developing countries.
- The most widely used sources of energy globally are fossil fuels.
- As developing countries become more developed, their reliance on fossil fuels for energy increases.
- As the world becomes more industrialized, the demand for energy increases.
- Availability, price, and governmental regulations influence which energy sources people use and how they use them.
- Wood is commonly used as fuel in the forms of firewood and charcoal. It is often used in developing countries because it is easily accessible.
- Peat is partially decomposed organic material that can be burned for fuel.
- Three types of coal used for fuel are lignite, bituminous, and anthracite. Heat, pressure, and depth of burial contribute to the development of various coal types and their qualities.
- Natural gas, the cleanest of the fossil fuels, is mostly methane.
- Crude oil can be recovered from tar sands, which are a combination of clay, sand, water, and bitumen.
- Fossil fuels can be made into specific fuel types for specialized uses (e.g., in motor vehicles).
- Cogeneration occurs when a fuel source is used to generate both useful heat and electricity.
- The global distribution of natural energy resources, such as ores, coal, crude oil, and gas, is not uniform and depends on regions' geologic history.
- The combustion of fossil fuels is a chemical reaction between the fuel and oxygen that yields carbon dioxide and water and releases energy.
- Energy from fossil fuels is produced by burning those fuels to generate heat, which then turns water into steam. That steam turns a turbine, which generates electricity
- Humans use a variety of methods to extract fossil fuels from the earth for energy generation.
- Hydrologic fracturing (fracking) can cause groundwater contamination and the release of volatile organic compounds.
- Nuclear power is generated through fission, where atoms of Uranium-235, which are stored in fuel rods, are split into smaller parts after being struck by a neutron. Nuclear fission releases a large amount of heat, which is used to generate steam, which powers a turbine and generates electricity.
- Radioactivity occurs when the nucleus of a radioactive isotope loses energy by emitting radiation.
- Uranium-235 remains radioactive for a long time, which leads to the problems associated with the disposal of nuclear waste.
- Nuclear power generation is a nonrenewable energy source. Nuclear power is considered a cleaner energy source because it does not produce air pollutants, but it does release thermal pollution and hazardous solid waste.
- Three Mile Island, Chernobyl, and Fukushima are three cases where accidents or natural disasters led to the release of radiation. These releases have had short- and long-term impacts on the environment.
- A radioactive element's half-life can be used to calculate a variety of things, including the rate of decay and the radioactivity level at specific points in time.
- Burning of biomass produces heat for energy at a relatively low cost, but it also produces carbon dioxide, carbon monoxide, nitrogen oxides, particulates, and volatile organic compounds. The overharvesting of trees for fuel also causes deforestation.
- Ethanol can be used as a substitute for gasoline. Burning ethanol does not introduce additional carbon into the atmosphere via combustion, but the energy return on energy investment for ethanol is low.

- Photovoltaic solar cells capture light energy from the sun and transform it directly into electrical energy. Their use is limited by the availability of sunlight.
- Active solar energy systems use solar energy to heat a liquid through mechanical and electric equipment to collect and store the energy captured from the sun.
- Passive solar energy systems absorb heat directly from the sun without the use of mechanical and electric equipment, and energy cannot be collected or stored.
- Solar energy systems have low environmental impact and produce clean energy, but they can be expensive. Large solar energy farms may negatively impact desert ecosystems.
- Hydroelectric power can be generated in several ways. Dams built across rivers collect water in reservoirs. The moving water can be used to spin a turbine. Turbines can also be placed in small rivers, where the flowing water spins the turbine.
- Tidal energy uses the energy produced by tidal flows to turn a turbine.
- Hydroelectric power does not generate air pollution or waste, but construction of the power plants can be expensive, and there may be a loss of or change in habitats following the construction of dams.
- Geothermal energy is obtained by using the heat stored in the Earth's interior to heat up water, which is brought back to the surface as steam. The steam is used to drive an electric generator.
- The cost of accessing geothermal energy can be prohibitively expensive, as is not easily accessible in many parts of the world. In addition, it can cause the release of hydrogen sulfide.
- Hydrogen fuel cells are an alternate to nonrenewable fuel sources. They use hydrogen as fuel, combining the hydrogen and oxygen in the air to form water and release energy (electricity) in the process. Water is the product (emission) of a fuel cell.
- Hydrogen fuel cells have low environmental impact and produce no carbon dioxide when the hydrogen is produced from water. However, the technology is expensive and energy is still needed to create the hydrogen gas used in the fuel cell.
- Wind turbines use the kinetic energy of moving air to spin a turbine, which in turn converts the mechanical energy of the turbine into electricity.
- Wind energy is a renewable, clean source of energy. However, birds and bats may be killed if they fly into the spinning turbine blades.
- Some of the methods for conserving energy around a home include adjusting the thermostat to reduce the use of heat and air conditioning, conserving water, use of energy-efficient appliances, and conservation landscaping.
- Methods for conserving energy on a large scale include improving fuel economy for vehicles, using BEVs (battery electric vehicles) and hybrid vehicles, using public transportation, and implementing green building design features.

Students will be able to…

- Explain environmental concepts, processes, or models in applied contexts.
- Calculate an accurate numeric answer with appropriate units.
- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: In theoretical contexts and In applied contexts.
- Describe environmental problems.
- Describe potential responses or approaches to environmental problems.
- Explain patterns and trends in data to draw conclusions.
- Justify a proposed solution, by explaining potential advantages.
- Explain environmental concepts and processes.
- Calculate an accurate numeric answer with appropriate units.

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**

    - Students will explain why fossil fuels are the most widely used energy resources if they are nonrenewable.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Half-life penny flip lab
- Energy usage and CO_2 production calculation lab
- Home energy audit
- Energy type super hero vs. super villain project
- Energy town research project
- Waste-to-Energy Facility field trip

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebooks

UNIT SEVEN – Atmospheric Pollution

Content Area: Advanced Placement Environmental Science

Unit Title: Atmospheric Pollution

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine the many sources of indoor and outdoor air pollution. The gases and particulates in the atmosphere come from both natural and human sources; once air pollution sources are identified, methods can be used to reduce it. Through legislation, the Clean Air Act regulates the emission of air pollutants that affect human health.

Approximate Length of Unit: 2.5 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-ESS3-1** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **HS-ESS3-2** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **HS-ESS3-3** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity
- **HS-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **HS-ESS3-6** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- **HS-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- **HS-ESS2-6** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

21^{st} Century Life and Career Skills:

- **9.3.12.AG-ENV.2** Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- **9.3.12.AG-ENV.4** Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).

Interdisciplinary Connections and Standards:

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **MA.N-Q.A.2** - Define appropriate quantities for the purpose of descriptive modeling.

- **HPE.2.1.12.C.2** Develop strategies that will impact local, state, national, and international public health efforts to prevent and control diseases and health conditions.
- **TECH.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.
- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **TECH.8.1.12.F.1** Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Unit Understanding

Students will understand that…

- sources and effects of air pollutants.
- causes and effects of photochemical smog and methods to reduce it.
- thermal inversion and its relationship with pollution.
- natural sources of CO_2 and particulates.
- sources of indoor air pollutants.
- effects of indoor air pollutants.
- air pollutants can be reduced at the source.
- sources and formation of acid deposition.
- effects of acid deposition on the environment.
- human activities that result in noise pollution and its effects.

Unit Essential Questions:

- Where does air pollution go once it is airborne?

Knowledge and Skills:

Students will know...

- Coal combustion releases air pollutants including carbon dioxide, sulfur dioxide, toxic metals, and particulates.
- The combustion of fossil fuels releases nitrogen oxides into the atmosphere. They lead to the production of ozone, formation of photochemical smog, and convert to nitric acid in the atmosphere, causing acid rain. Other pollutants produced by fossil fuel combustion include carbon monoxide, hydrocarbons, and particulate matter.
- Air quality can be affected through the release of sulfur dioxide during the burning of fossil fuels, mainly diesel fuels.
- Through the Clean Air Act, the Environmental Protection Agency (EPA) regulated the use of lead, particularly in fuels, which dramatically decreased the amount of lead in the atmosphere.
- Air pollutants can be primary or secondary pollutants.
- Photochemical smog is formed when nitrogen oxides and volatile organic hydrocarbons react with heat and sunlight to produce a variety of pollutants.
- Many environmental factors affect the formation of photochemical smog.
- Nitrogen oxide is produced early in the day. Ozone concentrations peak in the afternoon and are higher in the summer because ozone is produced by chemical reactions between oxygen and sunlight.

- Volatile Organic Compounds (VOCs), such as formaldehyde and gasoline, evaporate or sublimate at room temperature. Trees are a natural source of VOCs.
- Photochemical smog often forms in urban areas because of the large number of motor vehicles there.
- Photochemical smog can be reduced through the reduction of nitrogen oxide and VOCs.
- Photochemical smog can harm human health in several ways, including causing respiratory problems and eye irritation.
- During a thermal inversion, the normal temperature gradient in the atmosphere is altered as the air temperature at the Earth's surface is cooler than the air at higher altitudes.
- Thermal inversion traps pollution close to the ground, especially smog and particulates.
- CO_2 appears naturally in the atmosphere from sources such as respiration, decomposition, and volcanic eruptions.
- There are a variety of natural sources of particulate matter.
- Carbon monoxide is an indoor air pollutant that is classified as an asphyxiant.
- Indoor air pollutants that are classified as particulates include asbestos, dust, and smoke.
- Indoor air pollutants can come from natural sources, human-made sources, and combustion.
- Common natural source indoor air pollutants include radon, mold, and dust.
- Common human-made indoor air pollutants include insulation, Volatile Organic Compounds (VOCs) from furniture, paneling and carpets; formaldehyde from building materials, furniture, upholstery, and carpeting; and lead from paints.
- Common combustion air pollutants include carbon monoxide, nitrogen oxides, sulfur dioxide, particulates, and tobacco smoke.
- Radon-222 is a naturally occurring radioactive gas that is produced by the decay of uranium found in some rocks and soils.
- Radon gas can infiltrate homes as it moves up through the soil and enters homes via the basement or cracks in the walls or foundation. It is also dissolved in groundwater that enters homes through a well.
- Exposure to radon gas can lead to radon induced lung cancer, which is the second leading cause of lung cancer in America.
- Methods to reduce air pollutants include regulatory practices, conservation practices, and alternative fuels.
- A vapor recovery nozzle is an air pollution control device on a gasoline pump that prevents fumes from escaping into the atmosphere when fueling a motor vehicle.
- A catalytic converter is an air pollution control device for internal combustion engines that converts pollutants (CO, NOx, and hydrocarbons) in exhaust into less harmful molecules (CO_2, N_2, O_2, and H_2O).
- Wet and dry scrubbers are air pollution control devices that remove particulates and/or gases from industrial exhaust streams.
- Methods to reduce air pollution from coal burning power plants include scrubbers and electrostatic precipitators.
- Acid rain and deposition is due to nitrogen oxides and sulfur oxides from anthropogenic and natural sources in the atmosphere.
- Nitric oxides that causes acid deposition come from motor vehicles and coal-burning power plants. Sulfur dioxides that causes acid deposition come from coal-burning power plants.
- Acid deposition mainly affects communities that are downwind from coal-burning power plants.
- Acid rain and deposition can lead to the acidification of soils and bodies of water and corrosion of human-made structures.
- Regional differences in soils and bedrock affect the impact that acid deposition has on the region—such as limestone bedrock's ability to neutralize the effect of acid rain on lakes and ponds.
- Noise pollution is sound at levels high enough to cause physiological stress and hearing loss.
- Sources of noise pollution in urban areas include transportation, construction, and domestic and industrial activity.
- Some effects of noise pollution on animals in ecological systems include stress, the masking of sounds used to communicate or hunt, damaged hearing, and causing changes to migratory routes.

Students will be able to…

- Explain modifications to an experimental procedure that will alter results.
- Describe relationships among variables in data represented.
- Explain how environmental concepts and processes represented visually relate to broader environmental issues.
- Describe an aspect of a research method, design, and/or measure used.
- Explain patterns and trends in data to draw conclusions.
- Use data and evidence to support a potential solution.
- Identify a research method, design, and/or measure used.
- Describe the author's reasoning (use of evidence to support a claim).

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will explain where air pollution goes once it is airborne.
  - Students will use data to support a potential solution to an identified problem.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Indoor air pollution lab: CO_2 and Particulates
- Outdoor air pollution lab: Tropospheric Ozone and Particles
- Carolina Emissions lab
- Acid Rain Deposition Lab
- EPA Dirty Dozen Research project

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources
- Carolina Emissions lab kit
- Carolina Acid Rain Deposition Lab kit

Equipment & Materials:

- Projector
- Chromebooks

UNIT EIGHT – Aquatic and Terrestrial Pollution

Content Area: Advanced Placement Environmental Science

Unit Title: Aquatic and Terrestrial Pollution

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine pollution created by human activities directly impacts ecosystems in the air, on land, and in water. The source of pollution can sometimes be easy to identify, but other times the source is diffused. There are many human health issues that can be linked to pollution. Legislation has been created to reduce discharges of pollution in water and regulate drinking water.

Approximate Length of Unit: 4 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-ESS3-1** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity
- **HS-ESS3-2** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **HS-ESS3-3** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- **HS-ESS3-6** Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
- **HS-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- **HS-ESS2-6** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere

21^{st} Century Life and Career Skills:

- **9.3.12.AG-ENV.2** Evaluate the impact of public policies and regulations on environmental service system operations.
- **9.3.12.AG-ENV.3** Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.
- **9.3.12.AG-ENV.4** Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).

Interdisciplinary Connections and Standards:

- **MA.N-Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- **MA.N-Q.A.2** - Define appropriate quantities for the purpose of descriptive modeling.

- **HPE.2.1.12.C.2** Develop strategies that will impact local, state, national, and international public health efforts to prevent and control diseases and health conditions.
- **TECH.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.
- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **TECH.8.1.12.F.1** Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Unit Understanding

Students will understand that…

- differences between point and nonpoint sources of pollution.
- impacts of human activities on aquatic ecosystems.
- sources of endocrine disruptors.
- effects of endocrine disruptors on ecosystems.
- impacts of human activity on wetlands and mangroves.
- environmental effects of excessive use of fertilizers and detergents on aquatic ecosystems.
- effects of thermal pollution on aquatic ecosystems.
- effect of persistent organic pollutants (POPs) on ecosystems.
- importance of bioaccumulation and biomagnification.
- effects of bioaccumulation and biomagnification.
- different solid waste disposal methods.
- effects of solid waste disposal methods.
- changes to current practices that could reduce the amount of generated waste and their associated benefits and drawbacks.
- best practices in sewage treatment.
- method of lethal dose 50% (LD_{50}) and dose response curves.
- sources of human health issues that are linked to pollution.
- human pathogens and their cycling through the environment.

Unit Essential Questions:

- How does pollution impact your health?
- How can you decrease your waste?

Knowledge and Skills:

Students will know...

- A point source refers to a single, identifiable source of a pollutant, such as a smokestack or waste discharge pipe.
- Nonpoint sources of pollution are diffused and can therefore be difficult to identify, such as pesticide spraying or urban runoff.
- Organisms have a range of tolerance for various pollutants. Organisms have an optimum range for each factor where they can maintain homeostasis. Outside of this range, organisms may experience physiological stress, limited growth, reduced reproduction, and in extreme cases, death.

- Coral reefs have been suffering damage due to a variety of factors, including increasing ocean temperature, sediment runoff, and destructive fishing practices.
- Oil spills in marine waters cause organisms to die from the hydrocarbons in oil. Oil that floats on the surface of water can coat the feathers of birds and fur of marine mammals. Some components of oil sink to the ocean floor, killing some bottom-dwelling organisms.
- Oil that washes up on the beach can have economic consequences on the fishing and tourism industries.
- Oceanic dead zones are areas of low oxygen in the world's oceans caused by increased nutrient pollution.
- An oxygen sag curve is a plot of dissolved oxygen levels versus the distance from a source of pollution, usually excess nutrients and biological refuse.
- Heavy metals used for industry, especially mining and burning of fossil fuels, can reach the groundwater, impacting the drinking water supply.
- Litter that reaches aquatic ecosystems, besides being unsightly, can create intestinal blockage and choking hazards for wildlife and introduce toxic substances to the food chain.
- Increased sediment in waterways can reduce light infiltration, which can affect primary producers and visual predators. Sediment can also settle, disrupting habitats.
- When elemental sources of mercury enter aquatic environments, bacteria in the water convert it to highly toxic methylmercury.
- Endocrine disruptors are chemicals that can interfere with the endocrine system of animals.
- Endocrine disruptors can lead to birth defects, developmental disorders, and gender imbalances in fish and other species.
- Wetlands are areas where water covers the soil, either part or all of the time.
- Wetlands provide a variety of ecological services, including water purification, flood protection, water filtration, and habitat.
- Threats to wetlands and mangroves include commercial development, dam construction, overfishing, and pollutants from agriculture and industrial waste.
- Eutrophication occurs when a body of water is enriched in nutrients.
- The increase in nutrients in eutrophic aquatic environments causes an algal bloom. When the algal bloom dies, microbes digest the algae, along with the oxygen in the water, leading to a decrease in the dissolved oxygen levels in the water. The lack of dissolved oxygen can result in large die-offs of fish and other aquatic organisms.
- Hypoxic waterways are those bodies of water that are low in dissolved oxygen.
- Compared to eutrophic waterways, oligotrophic waterways have very low amounts of nutrients, stable algae populations, and high dissolved oxygen.
- Anthropogenic causes of eutrophication are agricultural runoff and wastewater release.
- Thermal pollution occurs when heat released into the water produces negative effects to the organisms in that ecosystem.
- Variations in water
- Persistent organic pollutants (POPs) do not easily break down in the environment because they are synthetic, carbon-based molecules (such as DDT and PCBs).affect the concentration of dissolved oxygen because warm water does not contain as much oxygen as cold water.
- Persistent organic pollutants (POPs) can be toxic to organisms because they are soluble in fat, which allows them to accumulate in organisms' fatty tissues.
- Persistent organic pollutants (POPs) can travel over long distances via wind and water before being redeposited.
- Bioaccumulation is the selective absorption and concentration of elements or compounds by cells in a living organism, most commonly fat-soluble compounds.
- Biomagnification is the increase in concentration of substances per unit of body tissue that occurs in successively higher trophic levels of a food chain or in a food web.
- Some effects that can occur in an ecosystem when a persistent substance is biomagnified in a food chain include eggshell thinning and developmental deformities in top carnivores of the higher trophic levels.

- Humans also experience harmful effects from biomagnification, including issues with the reproductive, nervous, and circulatory systems.
- DDT, mercury, and PCBs are substances that bioaccumulate and have significant environmental impacts.
- Solid waste is any discarded material that is not a liquid or gas. It is generated in domestic, industrial, business, and agricultural sectors.
- Solid waste is most often disposed of in landfills. Landfills can contaminate groundwater and release harmful gases.
- Electronic waste, or e-waste, is composed of discarded electronic devices including televisions, cell phones, and computers.
- A sanitary municipal landfill consists of a bottom liner (plastic or clay), a storm water collection system, a leachate collection system, a cap, and a methane collection system.
- Factors in landfill decomposition include the composition of the trash and conditions needed for microbial decomposition of the waste.
- Solid waste can also be disposed of through incineration, where waste is burned at high temperatures. This method significantly reduces the volume of solid waste but releases air pollutants.
- Some items are not accepted in sanitary landfills and may be disposed of illegally, leading to environmental problems. One example is used rubber tires, which when left in piles can become breeding grounds for mosquitoes that can spread disease.
- Some countries dispose of their waste by dumping it in the ocean. This practice, along with other sources of plastic, has led to large floating islands of trash in the oceans. Additionally, wildlife can become entangled in the waste, as well as ingest it.
- Recycling is a process by which certain solid waste materials are processed and converted into new products.
- Recycling is one way to reduce the current global demand on minerals, but this process is energy-intensive and can be costly.
- Composting is the process of organic matter such as food scraps, paper, and yard waste decomposing. The product of this decomposition can be used as fertilizer. Drawbacks to composting include odor and rodents.
- E-waste can be reduced by recycling and reuse. E-wastes may contain hazardous chemicals, including heavy metals such as lead and mercury, which can leach from landfills into groundwater if they are not disposed of properly
- Landfill mitigation strategies range from burning waste for energy to restoring habitat on former landfills for use as parks.
- The combustion of gases produced from decomposition of organic material in landfills can be used to turn turbines and generate electricity. This process reduces landfill volume.
- Primary treatment of sewage is the physical removal of large objects, often through the use of screens and grates, followed by the settling of solid waste in the bottom of a tank.
- Secondary treatment is a biological process in which bacteria break down organic matter into carbon dioxide and inorganic sludge, which settles in the bottom of a tank. The tank is aerated to increase the rate at which the bacteria break down the organic matter
- Tertiary treatment is the use of ecological or chemical processes to remove any pollutants left in the water after primary and secondary treatment.
- Prior to discharge, the treated water is exposed to one or more disinfectants (usually, chlorine, ozone, or UV light) to kill bacteria.
- Lethal dose 50% (LD_{50}) is the dose of a chemical that is lethal to 50% of the population of a particular species.
- A dose response curve describes the effect on an organism or mortality rate in a population based on the dose of a particular toxin or drug.
- It can be difficult to establish a cause and effect between pollutants and human health issues because humans experience exposure to a variety of chemicals and pollutants.
- Dysentery is caused by untreated sewage in streams and rivers.
- Mesothelioma is a type of cancer caused mainly by exposure to asbestos.

- Respiratory problems and overall lung function can be impacted by elevated levels of tropospheric ozone.
- Pathogens adapt to take advantage of new opportunities to infect and spread through human populations.
- Specific pathogens can occur in many environments regardless of the appearance of sanitary conditions.
- As equatorial-type climate zones spread north and south in to what are currently subtropical and temperate climate zones, pathogens, infectious diseases, and any associated vectors are spreading into these areas where the disease has not previously been known to occur.
- Poverty-stricken, low-income areas often lack sanitary waste disposal and have contaminated drinking water supplies, leading to havens and opportunities for the spread of infectious diseases.
- Plague is a disease carried by organisms infected with the plague bacteria. It is transferred to humans via the bite of an infected organism or through contact with contaminated fluids or tissues.
- Tuberculosis is a bacterial infection that typically attacks the lungs. It is spread by breathing in the bacteria from the bodily fluids of an infected person.
- Malaria is a parasitic disease caused by bites from infected mosquitoes. It is most often found in sub-Saharan Africa.
- West Nile virus is transmitted to humans via bites from infected mosquitoes.
- Severe acute respiratory syndrome (SARS) is a form of pneumonia. It is transferred by inhaling or touching infected fluids.
- Middle East Respiratory Syndrome (MERS) is a viral respiratory illness that is transferred from animals to humans.
- Zika is a virus caused by bites from infected mosquitoes. It can be transmitted through sexual contact.
- Cholera is a bacterial disease that is contracted from infected water.

Students will be able to…

- Describe environmental concepts and processes.
- Apply appropriate mathematical relationships to solve a problem, with work shown (e.g., dimensional analysis).
- Describe potential responses or approaches to environmental problems.
- Explain how environmental concepts and processes represented visually relate to broader environmental issues.
- Explain environmental concepts, processes, or models in applied contexts.
- Explain environmental concepts and processes.
- Identify a testable hypothesis or scientific question for an investigation.
- Use data and evidence to support a potential solution.
- Describe characteristics of an environmental concept, process, or model represented visually.
- Determine an approach or method aligned with the problem to be solved.
- Explain what the data implies or illustrates about environmental issues.
- Describe an aspect of a research method, design, and/or measure used.
- Explain relationships between different characteristics of environmental concepts, processes, or models represented visually: In theoretical contexts and In applied contexts

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will explain how environmental concepts and processes can relate to broader environmental issues.
  - Students will explain how pollution impacts your health.
- Unit project
- Topic Quizzes

- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Bioassay Mung Bean Toxicity Lab
- Personal Waste Inventory
- Disease brochure/website research project
- Wastewater treatment plant field trip
- Biomagnification paperclip model
- Water Pollution case study/ data analysis round robin
- Oil Spill Clean-up lab

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebooks

UNIT NINE – Global Change

Content Area: Advanced Placement Environmental Science

Unit Title: Global Change

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine the global impact of local and regional human activities. Humans can mitigate their impact through sustainable use of resources. Human activities can cause ozone depletion in the stratosphere and increases in the greenhouse gases in the atmosphere.

Approximate Length of Unit: 4 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-ESS2-2** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
- **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.
- **HS-ESS2-6** Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- **HS-ESS3-1** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **HS-ESS3-3** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
- **HS-ESS3-4** Evaluate or refine a technological solution that reduces impacts of human activities on natural 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.
- **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

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.1** Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- **9.3.12.AG-NR.3** Develop plans to ensure sustainable production and processing of natural resources.
- **9.3.GV.1** Explain the purpose and functions of government and public administration and the application of democratic principles in the process of governmental and administrative policymaking.

Interdisciplinary Connections and Standards:

- **TECH.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.

- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **TECH.8.2.12.D.4** Assess the impacts of emerging technologies on developing countries.
- **RI.11-12.2.** Determine two or more central ideas of a text, and analyze their development and how they interact to provide a complex analysis; provide an objective summary of the text.
- **MA.N-Q.A.2** - Define appropriate quantities for the purpose of descriptive modeling.
- **HPE.2.1.12.C.2** Develop strategies that will impact local, state, national, and international public health efforts to prevent and control diseases and health conditions.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Unit Understanding

Students will understand that…

- importance of stratospheric ozone to life on Earth.
- chemicals used to substitute for chlorofluorocarbons (CFCs).
- natural process of greenhouse gases.
- sources and potency of the greenhouse gases.
- threats to human health and the environment posed by an increase in greenhouse gases.
- changes in climate, both short- and long term, impact ecosystems.
- causes and effects of ocean warming.
- causes and effects of ocean acidification.
- environmental problems associated with invasive species and strategies to control them.
- species become endangered and strategies to combat the problem.
- human activities affect biodiversity and strategies to combat the problem.

Unit Essential Questions:

- Why are laws created to protect endangered species?
- How can local human activities have a global impact?

Knowledge and Skills:

Students will know...

- The stratospheric ozone layer is important to the evolution of life on Earth and the continued health and survival of life on Earth.
- Stratospheric ozone depletion is caused by anthropogenic factors, such as chlorofluorocarbons (CFCs), and natural factors, such as the melting of ice crystals in the atmosphere at the beginning of the Antarctic spring.
- A decrease in stratospheric ozone increases the UV rays that reach the Earth’s surface. Exposure to UV rays can lead to skin cancer and cataracts in humans.
- Ozone depletion can be mitigated by replacing ozone-depleting chemicals with substitutes that do not deplete the ozone layer. Hydrofluorocarbons (HFCs) are one such replacement, but some are strong greenhouse gases.
- The principal greenhouse gases are carbon dioxide, methane, water vapor, nitrous oxide, and chlorofluorocarbons (CFCs).
- While water vapor is a greenhouse gas, it doesn’t contribute significantly to global climate change because it has a short residence time in the atmosphere.
- The greenhouse effect results in the surface temperature necessary for life on Earth to exist.

- Carbon dioxide, which has a global warming potential (GWP) of 1, is used as a reference point for the comparison of different greenhouse gases and their impacts on global climate change. Chlorofluorocarbons (CFCs) have the highest GWP, followed by nitrous oxide, then methane.
- Global climate change, caused by excess greenhouse gases in the atmosphere, can lead to a variety of environmental problems including rising sea levels resulting from melting ice sheets and ocean water expansion, and disease vectors spreading from the tropics toward the poles. These problems can lead to changes in population dynamics and population movements in response.
- The Earth has undergone climate change throughout geologic time, with major shifts in global temperatures causing periods of warming and cooling as recorded with CO_2 data and ice cores.
- Effects of climate change include rising temperatures, melting permafrost and sea ice, rising sea levels, and displacement of coastal populations.
- Marine ecosystems are affected by changes in sea level, some positively, such as in newly created habitats on now-flooded continental shelves, and some negatively, such as deeper communities that may no longer be in the photic zone of seawater.
- Winds generated by atmospheric circulation help transport heat throughout the Earth. Climate change may change circulation patterns, as temperature changes may impact Hadley cells and the jet stream.
- Oceanic currents, or the ocean conveyor belt, carry heat throughout the world. When these currents change, it can have a big impact on global climate, especially in coastal regions.
- Climate change can affect soil through changes in temperature and rainfall, which can impact soil's viability and potentially increase erosion.
- Earth's polar regions are showing faster response times to global climate change because ice and snow in these regions reflect the most energy back out to space, leading to a positive feedback loop.
- As the Earth warms, this ice and snow melts, meaning less solar energy is radiated back into space and instead is absorbed by the Earth's surface. This in turn causes more warming of the polar regions.
- Global climate change response time in the Arctic is due to positive feedback loops involving melting sea ice and thawing tundra, and the subsequent release of greenhouse gases like methane.
- One consequence of the loss of ice and snow in polar regions is the effect on species that depend on the ice for habitat and food.
- Ocean warming is caused by the increase in greenhouse gases in the atmosphere.
- Ocean warming can affect marine species in a variety of ways, including loss of habitat, and metabolic and reproductive changes.
- Ocean warming is causing coral bleaching, which occurs when the loss of algae within corals cause the corals to bleach white. Some corals recover and some die.
- Ocean acidification is the decrease in pH of the oceans, primarily due to increased CO_2 concentrations in the atmosphere, and can be expressed as chemical equations.
- As more CO_2 is released into the atmosphere, the oceans, which absorb a large part of that CO_2, become more acidic.
- Anthropogenic activities that contribute to ocean acidification are those that lead to increased CO_2 concentrations in the atmosphere: burning of fossil fuels, vehicle emissions, and deforestation.
- Ocean acidification damages coral because acidification makes it difficult for them to form shells, due to the loss of calcium carbonate.
- Invasive species are species that can live, and sometimes thrive, outside of their normal habitat. Invasive species can sometimes be beneficial, but they are considered invasive when they threaten native species.
- Invasive species are often generalist, r-selected species and therefore may outcompete native species for resources.
- Invasive species can be controlled through a variety of human interventions.
- A variety of factors can lead to a species becoming threatened with extinction, such as being extensively hunted, having limited diet, being outcompeted by invasive species, or having specific and limited habitat requirements.
- Not all species will be in danger of extinction when exposed to the same changes in their ecosystem. Species that are able to adapt to changes in their environment or that are able to move to a new environment are less likely to face extinction.

- Selective pressures are any factors that change the behaviors and fitness of organisms within an environment.
- Species in a given ecosystem compete for resources like territory, food, mates, and habitat, and this competition may lead to endangerment or extinction.
- Strategies to protect animal populations include criminalizing poaching, protecting animal habitats, and legislation.
- HIPPCO (habitat destruction, invasive species, population growth, pollution, climate change, and over exploitation) describes the main factors leading to a decrease in biodiversity.
- Habitat fragmentation occurs when large habitats are broken into smaller, isolated areas. Causes of habitat fragmentation include the construction of roads and pipelines, clearing for agriculture or development, and logging.
- The scale of habitat fragmentation that has an adverse effect on the inhabitants of a given ecosystem will vary from species to species within that ecosystem.
- Global climate change can cause habitat loss via changes in temperature, precipitation, and sea level rise.
- Some organisms have been somewhat or completely domesticated and are now managed for economic returns, such as honeybee colonies and domestic livestock. This domestication can have a negative impact on the biodiversity of that organism.
- Some ways humans can mitigate the impact of loss of biodiversity include creating protected areas, use of habitat corridors, promoting sustainable land use practices, and restoring lost habitats.

Students will be able to…

- Describe environmental concepts and processes.
- Describe potential responses or approaches to environmental problems.
- Explain environmental concepts and processes.
- Explain how environmental concepts and processes represented visually relate to broader environmental issues.
- Interpret experimental data and results in relation to a given hypothesis.
- Describe environmental problems.
- Explain environmental concepts, processes, or models in applied contexts.
- Make a claim that proposes a solution to an environmental problem in an applied context.
- Use data and evidence to support a potential solution.
- Describe disadvantages, advantages, or unintended consequences for potential solutions.

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment:**
  - Students will explain how local human activities can have a global impact.
- Unit project
- Topic Quizzes
- AP Classroom Personal Progress Check
- Assigned Lab Report

Learning Activities:

- Green House Effect Simulation
- Wanted Dead or Alive poster/essay
- HIPPCO case studies
- Ocean Acidification lab
- Before the Flood Movie
- NASA Evidence of Climate Change Data Analysis

- CFC Ozone Destruction marshmallow model

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- AP Environmental Science Course and Exam Description (pdf or Binder)
- AP Classroom
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebooks

UNIT TEN – Post AP Exam

Content Area: Advanced Placement Environmental Science

Unit Title: Post AP Exam

Target Course/Grade Level:

11^{th}-12^{th} grade

Unit Summary: Students will examine ways to involve themselves in local and global environmental issues. Students will be emerged in solution based activities.

Approximate Length of Unit: 10 weeks

LEARNING TARGETS

NJ Student Learning Standards: Science:

- **HS-ETS1-1** Analyze a major challenge to specify qualitative and quantities criteria and constraints for solutions that account for societal needs and wants.
- **HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **HS-ESS3-2.** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*

21^{st} Century Life and Career Skills:

- **9.3.12.AG-NR.1** Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.
- **9.3.12.AG-NR.2** Analyze the interrelationships between natural resources and humans.
- **9.3.12.AG-NR.3** Develop plans to ensure sustainable production and processing of natural resources.
- **9.3.GV.1** Explain the purpose and functions of government and public administration and the application of democratic principles in the process of governmental and administrative policymaking.

Interdisciplinary Connections and Standards:

- **TECH.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.
- **TECH.8.1.12.D.1** Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
- **TECH.8.2.12.D.4** Assess the impacts of emerging technologies on developing countries.
- **RI.11-12.2.** Determine two or more central ideas of a text, and analyze their development and how they interact to provide a complex analysis; provide an objective summary of the text.
- **HPE.2.1.12.C.2** Develop strategies that will impact local, state, national, and international public health efforts to prevent and control diseases and health conditions.

NJ SLS Companion Standards:

- **NJSLSA.R1**. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- **NJSLSA.W1.** Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Unit Understanding

Students will understand that…

- human activities affect biodiversity.
- human activities affect human health.
- economics and environmental factors lead policy making.
- strategies to combat the problem.

Unit Essential Questions:

- What can humans do at an individual, local, national, and worldwide level to combat various environmental problems?

Knowledge and Skills:

Students will know...

- Environmental problems covered throughout the year.
- Some ways humans can mitigate the impact of loss of biodiversity include creating protected areas, use of habitat corridors, promoting sustainable land use practices, and restoring lost habitats.
- Large problems such as climate change must be dealt with on a global level for large scale change to occur.
- Individuals can help or hurt the solution.
- Economic and environmental services are used to make cost-benefit analyzes to make decisions that affect the human population.

Students will be able to…

- Describe potential responses or approaches to environmental problems.
- Explain environmental concepts and processes.
- Explain how environmental concepts and processes represented visually relate to broader environmental issues.
- Interpret experimental data and results in relation to a given hypothesis.
- Describe environmental problems.
- Explain environmental concepts, processes, or models in applied contexts.
- Make a claim that proposes a solution to an environmental problem in an applied context.
- Use data and evidence to support a potential solution.
- Describe disadvantages, advantages, or unintended consequences for potential solutions.

EVIDENCE OF LEARNING

Assessment:

- **End of Unit Assessment Project**
  - Students will explain what humans can do at an individual, local, national, and worldwide level to combat various environmental problems
- Topic Quizzes

Learning Activities:

- Environmental Problem Personal Project/Presentation
- Turtle Back Zoo Conservation field trip

RESOURCES

Teacher Resources:

- Textbook- 2019 Environmental Science for the AP Course Third Edition by Andrew Friedland & Rick Relyea
- Chromebooks- online resources

Equipment & Materials:

- Projector
- Chromebooks