Environmental Science

Course Number: 3900 and 3920

Course Level: Honors and Academic

Grade: High School

Time/Credit: 18 weeks / 1 credit

Development Date: 2025 – 2026

Central Bucks School District
20 Welden Drive
Doylestown, PA 18901

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Central Bucks School District
Teaching and Learning Principles

The Central Bucks School District's K-12 science education principles are aligned with the **Pennsylvania S**cience, **T**echnology & **E**ngineering, and **E**nvironmental **L**iteracy & **S**ustainability **(STEELS)** Standards, which were adopted in July 2022**.** The STEELS Standards guide the study of the natural and human-made world through inquiry, problem solving, critical thinking, and authentic exploration. There are six principles that are important in the teaching of science, and they include:

- Children are born investigators.
- Science must focus on core ideas and practices.
- Understanding develops over time.
- Science and engineering require both knowledge and practices.
- Teaching science must connect with student interests.
- In the teaching of science, we promote equity.

Therefore, the goal of science education is to ensure that all students will be able to engage as technological and engineering literate members of a global society, using their learning to:

1. Approach science as a reliable and tentative way of knowing and explaining the natural world and designed world.
2. Weigh evidence and use scientific approaches to ask questions, investigate, and make informed decisions.
3. Make and use observations to analyze relationships and patterns to explain phenomena, develop models, and make predictions.
4. Evaluate systems, to connect how form determines function and how any change to one component affects the entire system.
5. Explain how the natural and designed worlds are interrelated, and the application of scientific knowledge and technology can have beneficial, detrimental, or unintended consequences.

Sources:

- National Research Council (NRC). 2012. *A Framework for K–12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: National Academies Press.
- Pennsylvania Department of Education (PDE). 2023. *Communities - SAS (pdesas.org)*
- Pennsylvania Department of Education (PDE). 2023. *STEELS Hub: Curriculum Frameworks: Science Long Term Transfer Goals*

Central Bucks School District
Enduring Understandings

Students will understand that:

Earth and Space Science

- The Universe is composed of a variety of different objects, which are organized into systems, each of which develops according to accepted physical processes and laws.
- Earth is a complex and dynamic set of interconnected systems (e.g. geosphere, hydrosphere, atmosphere, biosphere) that interact over a wide range of temporal and spatial scales.
- The Earth's surface processes affect and are affected by human activities.

Life Science

- All organisms are made of cells and can be characterized by common aspects of their structure and functioning.
- Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment.
- Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents.
- Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth.

Physical Science

- Matter can be understood in terms of the types of atoms present and the interactions both between and within atoms.
- All forces between objects arise from a few types of interactions: gravity, electromagnetism, and the strong and weak nuclear interactions.
- Interactions of objects or systems of objects can be predicted and explained using the concept of transfer of energy from one object or system of objects to another.
- Waves are a repeating pattern of motion that transfers energy from place to place without overall displacement of matter.

Environmental Literacy and Sustainability

- Living things, including humans, utilize natural resources in ways that impact agricultural and environmental systems.
- Human cultures and societies experience and interact with the environment in various ways.
- Watersheds and wetlands function as interconnected systems that support, impact, and are influenced by living things.
- The environment provides multi-faceted opportunities to develop and apply interdisciplinary literacy skills to investigate complex issues at various scales.
- Conducting scientific investigations using place-based inquiry and authentic, outdoor field experience(s) are essential to understanding local environmental issues.
- Best management practices and data driven resource management, as well as environmental laws and policies, encourage environmental sustainability.
- Environmental stewardship practices are essential to improving environmental quality, sustainability, and community well-being.
- Environmental justice plays an important role in providing equitable protection from environmental hazards or concerns for all people.

Technology and Engineering

- The study of technology and engineering requires knowledge of the natural world and the human-made world.
- Design is a fundamental human activity.
- There is no single, best solution as designs can always be improved and refined.

Central Bucks School District
Essential Questions

Students will understand:

Earth and Space Science

- What is the Universe and what is Earth's place in it?
- How and why is Earth constantly changing?
- How do Earth's processes and human activities affect each other?

Life Science

- How do organisms interact with their environment and what are the effects of these interactions?
- How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics?
- How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms?

Physical Science

- How can one explain the structure, properties, and interactions of matter?
- How can one explain and predict interactions between objects within systems?
- How is energy transferred and conserved?
- How are waves used to transfer energy and information?

Environmental Literacy and Sustainability

- How do living things utilize natural resources in ways that impact agricultural and environmental systems? How do agricultural systems interact with environmental systems?
- How do human cultures and societies experience, interact, and value local, regional, and/or global environments? How do various human cultures express their beliefs about nature and the environment? How are natural resources managed by people from various cultures and communities?
- How do watersheds and wetlands function as interconnected systems that support, impact, and are influenced by living things? How do human actions impact the functions of watersheds and wetlands?
- How do investigations of local environmental issues expand understanding and facilitate potential solutions to other local, regional, and/or global environmental issues?
- How do we balance societal values, practices, and cost-benefit analysis (long-term and short-term) in addressing environmental issues? How can conducting local field investigations lead to identifying, understanding, and addressing environmental issues in my community?
- How do actions and regulations support the equitable availability of resources for current and future generations?
- How can human actions improve environmental quality, sustainability, and community well-being?
- How do human actions impact environmental justice issues for individuals and communities? How do human actions impact the equitable access, use, and disposal of natural resources?

Technology and Engineering

- Why is it important to have an understanding of the natural and human-made worlds?
- Why is design important to human activity?
- Why is there no single correct solution in design?

Central Bucks School District – Course of Study

Course Overview

Desired Results

Course Description:

3920 Academic Environmental Science: (18 weeks, 1 credit)

Environmental Science introduces students to the complex and interconnected systems that shape our planet. Students begin by exploring the geosphere, hydrosphere, and atmosphere, gaining a foundational understanding of Earth's systems and how they interact. The course then examines the importance of sustaining these systems, emphasizing natural resources, human impact, and conservation strategies. In the ecology unit, students investigate relationships between organisms and their environments, focusing on energy flow, biodiversity, and population dynamics. The final unit builds students' environmental literacy, encouraging them to analyze environmental challenges, evaluate solutions, and consider sustainability from multiple perspectives. Throughout the course, students engage in hands-on investigations and real-world problem solving, developing critical thinking skills and a deeper understanding of Earth's systems and their environment.

3900 Honors Environmental Science: (18 weeks, 1 credit)

In Honors Environmental Science, students are introduced to the complex and interconnected systems that shape our planet. Students begin by exploring the geosphere, hydrosphere, and atmosphere, developing a comprehensive understanding of Earth's systems and how they interact. The course emphasizes sustaining these systems, with an advanced focus on natural resources, human impact, and conservation strategies. Students investigate relationships between organisms and their environments, focusing on energy flow, biodiversity, population dynamics, and environmental literacy. Students will engage in rigorous hands-on investigations, simulations, and real-world problem solving, while developing high-level critical thinking and scientific communication skills. Honors students will examine a variety of nonfiction texts that deepen their understanding of environmental challenges.

Committee Members**:** Stacy Caldwell, Matthew Coverdale, Kyle Dennis, Christina Gillespie, Jennifer Yeager

Acceptable Evidence.

Course Grading:

Marking Period 1 – 45%

Marking Period 2 – 45%

Final Exam – 10%

Environmental Science Pacing Guide

Content	Days
Unit 1 – Earth Systems Interactions	**35**
Earth's Formation & Geologic History	5
Formative or Summative Assessments Interventions and Enrichments	1
Plate Tectonics & Earth's Interior	6
Formative or Summative Assessments Interventions and Enrichments	1
Feedback & Changing Earth's Systems	6
Formative or Summative Assessments Interventions and Enrichments	1
Properties of Water & Water's Role in Earth Systems	6
Formative or Summative Assessments Interventions and Enrichments	1
Atmosphere, Climate Change, and Coevolution of Earth's Systems	6
Review & Unit 1- District Common Summative Assessment	2
Unit 2 –Ecology & Ecosystem Dynamics	**28**
Energy, Matter, and Ecosystem Dynamics	9
Formative or Summative Assessments Interventions and Enrichments	1
Biodiversity and Ecosystem Stability	7
Formative or Summative Assessments Interventions and Enrichments	1
Population Dynamics, Biodiversity, and Human Impacts	8
Review & Unit 2- District Common Summative Assessment	2
Unit 3 – Human Impact & Sustainability	**12**
Human Dependence on and Use of Resources	2
Formative or Summative Assessments Interventions and Enrichments	1
Climate, Hazards, and Earth System Interactions	2
Formative or Summative Assessments Interventions and Enrichments	1
Human Impacts on Ecosystems and Biodiversity	2
Formative or Summative Assessments Interventions and Enrichments	1
Sustainability and Environmental Decision-Making	1
Review & Unit 3- District Common Summative Assessment	2
Unit 4 – Environmental Literacy & Action	**8**
Environmental Literacy: Local environmental issue investigation, Data analysis and research, Proposed solutions and communication	6

Environmental Literacy Capstone Project- District Common Unit Summative Assessment	2
Review & Final Exam	**2**
Total Days	**85**

NOTE: Additional remediation in standards/content from the grade level (or previous grade level) where the student completes this course will be provided for students when the teacher determines a student has not yet mastered that content. Enrichment opportunities will also be provided to meet the needs of students that acquire an understanding of the content faster than their class peers.

Required Texts and Software

Required Texts/Software:

- **Cengage:** National Geographic Environmental Science-Sustaining Your World (1st edition updated 2023)
  ISBN: 9780357541845
- **Biozone** Earth and Space Science (2nd edition 2022)
  ISBN: 9781988566931

Supplementary Texts/Software:

- **Pearson** Earth Science (2018)
  ISBN: 9781323205877
- **Explore Learning (Explorelearning.com):** *ExploreLearning.com houses the world's largest library of interactive online simulations for math and science education in grades 3-12. The online simulations are called Gizmos.*

Desired Results:

Essential Questions

- How do scientists use evidence from rocks, fossils, planetary materials, and radiometric data to explain Earth's origin and age?
- What evidence supports the structure of Earth's interior and the theory of plate tectonics?
- How and why is earth constantly changing and how do Earth's major systems interact?
- How do internal and surface processes interact to shape Earth's landscapes over different spatial and temporal scales?
- How does energy flow through Earth's systems and drive climate patterns and feedback mechanisms?
- How do the physical and chemical properties of water influence Earth materials and surface processes?
- How do interactions among the atmosphere, hydrosphere, geosphere, and biosphere regulate climate and environmental change?
- How have Earth's systems and life influenced one another throughout geologic history?
- How do scientists use data, modeling, and system analysis to predict future changes in Earth's climate and biodiversity?

Enduring Understandings:

Students will understand that…

- Earth's history is recorded in rocks, fossils, and geologic structures; these provide evidence of formation, change, and evolution.
- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old.
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.
- Spontaneous radioactive decay follows a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.
- The structure and dynamics of Earth's interior drive plate motion, surface features, and long-term cycling of matter through thermal convection and tectonic processes.
- Earth's surface is continuously reshaped by interactions among constructive and destructive forces operating across multiple spatial and temporal scales.
- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space.
- Water's molecular structure and physical properties make it essential for transferring energy and matter and for shaping Earth's surface through weathering, erosion, and deposition.
- Carbon, water, and energy cycle through interconnected Earth systems, linking atmospheric, biological, geological, and hydrological processes.
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
- Earth and life coevolve; biological processes influence atmospheric and geochemical conditions, while environmental changes shape biodiversity and evolution.
- Scientific models, data analysis, and evidence-based argumentation are essential tools for understanding past Earth processes and forecasting future system impacts.

Knowledge:

Students will know…

- **Earth's Formation & Geologic History**: Students will know how Earth formed and differentiated into layers; how radiometric dating is used to determine the age of rocks. Vocabulary: Earth's differentiation, crust, mantle, core, Lithosphere, asthenosphere, Radiometric dating, Half-life, Continental Crust, Oceanic Crust.
- **Plate Tectonics & Earth's Interior**: Students will know the structure of Earth's interior, the role of mantle convection in driving plate motion, the differences between the lithosphere and asthenosphere, and how seismic data reveals Earth's structure. Vocabulary: Plate tectonics, Subduction, Rift zone, Mid-ocean ridge, Mantle convection, Seismic waves (P-waves, S-waves), Lithosphere, asthenosphere, Earthquake epicenter and focus, Hotspot.
- **Feedback and Changing the Earth's Systems**: Students will know how energy flows through Earth's systems, the organization of climate systems, how feedback mechanisms operate, and how ice sheets influence climate. Vocabulary: Atmosphere, Climate vs. weather, Climate system, Energy flow, radiation, conduction, convection, Feedback mechanisms (positive and negative), Ice sheets, glaciers, Atmospheric circulation.
- **Properties of Water & Water's Role in Earth Systems:** Students will know how water moves through the hydrologic cycle, the properties of water that enable it to shape Earth's surface. Vocabulary: Hydrologic cycle, evaporation, condensation, precipitation, Infiltration, runoff, Water density, polarity, and specific heat.
- **Atmosphere, Climate Change & Coevolution of Earth's Systems**: Students will know the layers of the atmosphere, how the air circulates, the impacts on climate, how changes in Earth's Atmosphere leads to changes in biodiversity, how carbon cycles between all spheres and the combustion of fossil fuels can cause warming in the atmosphere. Students will know how changes in Earth's atmosphere have influenced the evolution and distribution of life and how organisms have altered atmospheric conditions over time. Vocabulary: troposphere, stratosphere, mesosphere, thermosphere, exosphere, cryosphere, greenhouse effect, greenhouse gases, ocean acidification, sea-level, carbon cycle, hydrosphere, atmosphere, geosphere, biosphere, carbon dioxide, climate model, precipitation, pH, weathering

Skills:

Students will be able to:

Earth's Formation & Geologic History:

- Analyze evidence from Earth materials, meteorites, and radiometric dating to construct an account of Earth's formation and early history.
- Use radiometric dating to determine the age of rocks and fossils.

Plate Tectonics & Earth's Interior:

- Model mantle convection and explain its role in plate motion.
- Evaluate evidence from continental and oceanic crust to support the theory of plate tectonics.
- Identify lithosphere and asthenosphere in models of Earth's interior.

Feedback and Changing the Earth's Systems

- Model energy flow through Earth's systems and describe effects on climate.
- Identify feedback mechanisms in climate systems and predict their impact.
- Analyze geoscience data to explain how changes in one Earth system create feedbacks that influence other Earth systems.

Properties of Water & Water's Role in Earth Systems

- Plan and conduct investigations to determine how the properties of water influence Earth materials and surface processes.
- Model the hydrologic cycle and trace water movement through Earth systems.
- Analyze properties of water that shape Earth's surface.

Atmosphere, Climate Change & Coevolution of Earths Systems.

- Analyze how atmospheric structure and circulation influence weather and climate patterns.
- Model carbon movement among geosphere, hydrosphere, atmosphere, and biosphere.
- Analyze climate data to identify trends and patterns.
- Use predictive models to forecast potential climate changes and impacts.

- Analyze how surface processes impact biodiversity.
- Construct an evidence-based argument explaining how Earth's systems and life have influenced one another throughout geologic history.

Priority Standards:
3.3.9-12.E: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.
3.3.9-12.F: 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. Assessment Boundary: N/A
3.3.9-12.G: 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. Assessment Boundary: N/A
3.3.9-12.H: Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems. Assessment Boundary: N/A
3.3.9-12.I: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface. Assessment Boundary: N/A
3.3.9-12.J: 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. Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.
3.3.9-12.K: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. Assessment Boundary: N/A
3.3.9-12.L: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Assessment Boundary: N/A
3.3.9-12.N: Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.
3.3.9-12.S: 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. Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts

Supporting Standards:
CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
CC.3.5.9-10.B: Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
CC.3.5.9-12.B: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms
CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
CC.3.6.9-12.A: Write arguments focused on discipline-specific content
CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Acceptable Evidence:

Performance Tasks:

- Scientific Writing
- Problem Solving Activities
- Real-world Application
- Laboratory/Safety Skills

Acceptable Evidence of Learning other than Performance Tasks:

- Mastery Checks
  - Critical Thinking Questions
  - Summary of Key Concepts

Formative Assessment:

- Learning Checks
  - Warm-ups
  - Closure/ Exit Tickets
  - Open ended responses

Summative Assessment:

- Section Assessments (Quiz)
- Project based learning opportunities
- District Common Unit Summative Assessment
  - Multiple Choice and Free Response
    - Scientific inquiry questions

Suggested Learning Experiences and Instruction

Learning Experiences:

Earth's Formation & Geologic History - Students will:

- Investigate methods of estimating age through relative and absolute comparisons.
- Analyze geological processes shaping Earth's surface through rock formation and tectonic interactions.
- Compare properties of continental and oceanic crust using modeling and sample data.
- Conduct radiometric dating investigations interpreting decay models and half-life data.
- Examine mineral and extraterrestrial evidence to construct explanations of Earth's age and early formation.
- Analyze robotic exploration and probe mission datasets to compare Earth with other planetary bodies.
- Construct geologic timelines integrating fossil, mineral, and planetary evidence.

Plate Tectonics & Earth's Interior – Students will:

- Investigate processes that continually reshape Earth's surface using data analysis and modeling.
- Map Earth's internal structure using seismic data and Earth layer models.
- Model lithosphere and asthenosphere interactions to explain crustal movement.
- Analyze continental motion patterns as evidence of tectonic processes.
- Examine sources of internal heat and their role in convection.
- Investigate temperature gradients within Earth's interior through modeling and interpretation of data.
- Develop and refine models demonstrating mantle convection and plate boundary interactions.

Feedback & Changing Earth's Systems– Students will:

- Analyze interactions between constructive and destructive surface processes through modeling and case studies.
- Investigate positive and negative feedback mechanisms influencing climate systems.
- Analyze how feedback mechanisms, including changes in Earth's reflectivity, can amplify or reduce environmental change.
- Examine long-term environmental changes such as glaciation patterns and climate shifts.
- Use system models to predict how changes in one Earth system influence others.

Properties of Water & Water's Role in Earth's Systems – Students will:

- Investigate molecular and physical properties of water through laboratory exploration.
- Model hydrologic cycling across Earth's systems.
- Examine the role of water in melting and geological transformation processes.
- Conduct investigations demonstrating water's influence on erosion, deposition, and surface change.
- Analyze connections between water properties and energy/matter transfer across systems.

Atmosphere, Climate Change, & Coevolution of Earth's Systems – Students will:

- Analyze global temperature datasets and develop explanations for climate trends.
- Investigate atmospheric structure and energy transfer processes.
- Model atmospheric circulation patterns and climate interactions.
- Examine coevolution of life and Earth systems using environmental and biological case studies.
- Analyze historical atmospheric composition changes.
- Investigate impacts of the Great Oxygenation Event on Earth systems.
- Examine relationships between environmental change and biodiversity patterns.
- Model carbon cycling among Earth systems.
- Simulate climate change scenarios and interpret predictive models.
- Integrate ecological, geological, and atmospheric evidence to model system interactions over time.

Instructional Strategies: Instruction in this unit is anchored in real-world phenomena and case studies and uses the 5E learning cycle.

Earth's Formation & Geologic History

- Engage: Introduce phenomena such as rock layers, fossils, or planetary comparisons to prompt questions about Earth's origin and age.
- Explore: Students investigate radiometric dating, analyze rock and fossil evidence, and construct geologic timelines using models and data.
- Explain: Students develop explanations for Earth's formation and age using evidence.
  Direct instruction clarifies geologic history, radioactive decay, and early Earth processes.
- Honors Level - Elaborate: Students compare Earth with other planetary bodies and refine models of Earth's early development.

Plate Tectonics & Earth's Interior

- Engage: Use phenomena such as earthquakes, volcanoes, or continental movement to generate questions about Earth's structure.
- Explore: Students analyze seismic data, model Earth's layers, and investigate plate boundary interactions.
- Explain: Students explain how Earth's interior drives plate motion. Direct instruction clarifies mantle convection, lithosphere interaction, and tectonic processes.
- Honors Level - Elaborate: Students refine models and analyze patterns in tectonic activity across different regions.

Feedback & Changing Earth's Systems

- Engage: Present phenomena such as climate shifts or glacial changes to prompt questions about system interactions and feedback.
- Explore: Students investigate feedback mechanisms, analyze case studies, and model system interactions.
- Explain: Students explain how feedback processes influence climate and Earth systems.
  Direct instruction clarifies energy flow and positive and negative feedbacks.
- Honors Level - Elaborate: Students use models and data to predict how changes in one Earth system impact others.

Properties of Water & Water's Role in Earth's Systems

- Engage: Use phenomena such as erosion, flooding, or water movement to prompt questions about water's role in shaping Earth.
- Explore: Students investigate water's properties, model the hydrologic cycle, and examine its role in surface processes.

- Explain: Students explain how water transfers energy and matter within and across systems.
  Direct instruction clarifies water properties and system interactions.
- Honors Level - Elaborate: Students connect water processes to broader Earth system changes and refine models of water movement.

Atmosphere, Climate Change, & Coevolution of Earth's Systems

- Engage: Introduce phenomena such as rising temperatures or atmospheric changes to generate questions about climate and system interactions.
- Explore: Students analyze climate data, model atmospheric processes, and investigate carbon cycling and system interactions.
- Explain: Students explain climate patterns and the coevolution of Earth's systems and life.
  Direct instruction clarifies atmospheric structure, energy transfer, and climate processes.
- Honors Level - Elaborate: Students interpret climate models, connect system interactions, and predict future changes.

Differentiation: Intervention/Enrichment Options: Instruction is differentiated through scaffolded modeling, data analysis, and investigation tasks to support all learners.

Intervention:

- Scaffold content through vocabulary support, guided notes, graphic organizers, and models.
- Provide structured investigations, teacher-guided data analysis, and frequent formative feedback.
- Use simulations, visuals, modified datasets, and flexible pacing to support understanding.

Enrichment

- Extend learning through independent research, student-designed investigations, and analysis of additional datasets.
- Apply advanced quantitative models, digital simulations, and evidence-based evaluation of scientific claims.
- Connect learning to climate forecasting, engineering solutions, sustainability, and real-world environmental challenges.

For Language Development:

- Create a student-made dictionary that includes terms, definitions, and examples organized by chapter.
- Teach only essential vocabulary (as indicated in knowledge section).
- Pre-teach vocabulary or have the ELD teacher pre-teach it if possible.

Desired Results:

Essential Questions:

- How do the Earth's major spheres support life?
- What are the major ecosystem components?
- How do organisms interact with one another and with their environment within ecosystems?
- How does energy flow and matter cycle through ecosystems?
- What is biodiversity and why is it important?
- What role do species play in ecosystems
- How does life on Earth change over time?
- What factors affect biodiversity
- How do species interact?
- How do biodiversity and ecosystem services support life on Earth?
- How do environmental changes impact ecosystems?
- What factors regulate population growth and ecosystem stability?

Enduring Understandings:

Students will understand that…

- Earth's spheres (geosphere, hydrosphere, atmosphere, biosphere) are interconnected, and energy from the Sun drives ecosystem processes.
- Energy flows through ecosystems via producers, consumers, and decomposers, with energy loss at each trophic level.
- Matter cycles through ecosystems (water, carbon, nitrogen, phosphorus), supporting life and ecosystem stability.
- Food chains, food webs, and energy pyramids model ecosystem relationships and energy transfer.
- Scientists use observations, experiments, models, and data analysis to study ecosystems.
- Biodiversity exists at genetic, species, and ecosystem levels and enhances ecosystem resilience and stability.
- Species play different roles; keystone species and invasive species can significantly influence ecosystem structure.
- Changes in biodiversity affect ecosystem function and can be measured through scientific sampling.
- Population size and growth are influenced by resources, environmental conditions, and species interactions.
- Resource partitioning and symbiotic relationships shape species interactions and ecosystem stability.
- Predator–prey dynamics and succession regulate population and ecosystem changes over time.
- As the environment and populations of species change, there are resulting changes in ecosystems
- Human activities impact ecosystems, but conservation and sustainability strategies can preserve biodiversity and ecosystem services.
- Group behaviors affect individual survival, reproduction, and population stability.

Knowledge:

Energy, Matter, and Ecosystem Dynamics **-** Students will know…

- Earth's interconnected spheres - Ecosystems exist within Earth's interconnected spheres (geosphere, hydrosphere, atmosphere, biosphere) and that energy entering Earth's systems, primarily from the Sun, drives ecological processes. They will know how the greenhouse effect influences Earth's energy balance and affects ecosystem conditions.
- Trophic Levels and Energy Transfer - Energy enters ecosystems through producers and is transferred through trophic levels to consumers and decomposers. They will know that energy transfer between trophic levels is inefficient, limiting population size and ecosystem productivity.

- Food Chains, Food Webs, and Energy Pyramids - Food chains and food webs model feeding relationships within ecosystems and how energy pyramids illustrate decreasing energy availability at higher trophic levels.
- Matter Cycling in Ecosystems - Matter is conserved and cycles through ecosystems via biogeochemical processes, including the water, carbon, nitrogen, and phosphorus cycles. They will know how these cycles support life and contribute to ecosystem stability.
- How Scientists Study Ecosystems - Scientists use field studies, experiments, models, and data analysis to study ecosystems and understand interactions among organisms and their environment.
- Vocabulary: Earth systems, biosphere, atmosphere, hydrosphere, geosphere, energy input, greenhouse effect, systems thinking, Energy flow, producer, consumer, decomposer, trophic level, autotroph, heterotroph, energy efficiency, Food chain, food web, energy pyramid, biomass pyramid, trophic transfer, ecological efficiency, Biogeochemical cycles, carbon cycle, water cycle, nitrogen cycle, phosphorus cycle, nutrient cycling, matter conservation, Ecological model, field study, simulation, variable, data analysis, systems model

Biodiversity and Ecosystem Stability - Students will know…

- Biodiversity varies across ecosystems and that changes in biodiversity can significantly impact ecosystem stability and function.
- Different levels of biodiversity, including genetic diversity, species diversity, and ecosystem diversity, and how biodiversity contributes to healthy ecosystems.
- Biodiversity can be measured and quantified using sampling methods and data analysis.
- Roles of Species in Ecosystems: Species play different roles within ecosystems, and that keystone and invasive species can disproportionately affect ecosystem structure and resilience.
- Vocabulary: Biodiversity, ecosystem stability, ecosystem function, species loss, Species richness, genetic diversity, ecosystem diversity, Biodiversity index, sampling, population sampling, data interpretation, Keystone species, invasive species, native species, ecosystem resilience.

Population Dynamics and Species Interactions - Students will know…

- Population size and growth are influenced by environmental conditions, resource availability, and interactions among organisms.
- Resource partitioning reduces competition by allowing species to occupy different niches within an ecosystem.
- Different types of symbiotic relationships and how these interactions affect population size and ecosystem balance.
- Predator–prey interactions regulate population sizes and create feedback loops within ecosystems.
- Ecological Succession: Ecosystems change over time through primary and secondary succession following disturbance.
- A complex set of interactions within an ecosystem can keep its number and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
- Population Growth Models: Populations grow in predictable patterns influenced by limiting factors and carrying capacity.
- Changes (induced by human activity) in the environment- including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change- can disrupt an ecosystem and threated the survival of some species.
- Human Impacts and Ecosystem Management: Human activities affect ecosystems and how conservation and sustainability strategies can support ecosystem health.
- Vocabulary: Population dynamics, population density, species interaction, Resource partitioning, niche, competition, Symbiosis, mutualism, commensalism, parasitism, Predator, prey, population regulation, feedback loop, Ecological succession, primary succession, secondary succession, disturbance, Exponential growth, logistic growth, carrying capacity, limiting factors, Sustainability, conservation, ecosystem, habitat fragmentation, restoration ecology, human disturbances, biodiversity

Skills:
Students will be able to…
Energy, Matter, and Ecosystem Dynamics

- Use models and data to describe energy flow through ecosystems, including trophic levels, food chains, and food webs.
- Analyze and calculate energy transfer efficiency and its impact on ecosystem productivity.
- Represent matter cycling (carbon, nitrogen, water, phosphorus) mathematically and explain its role in ecosystem stability.
- Construct and interpret ecological models to predict effects of changes in energy or matter flow.

Biodiversity and Ecosystem Stability

- Evaluate evidence to explain how biodiversity contributes to ecosystem resilience and stability.
- Use data to assess the effects of species loss, invasive species, or keystone species on ecosystems.
- Apply sampling and quantitative methods to measure species richness and diversity.
- Revise explanations of ecosystem function based on new data regarding biodiversity changes.

Population Dynamics and Species Interactions

- Analyze factors affecting population growth, carrying capacity, and species interactions using mathematical or computational representations.
- Interpret and construct population growth models (exponential, logistic) to predict changes under different environmental conditions.
- Evaluate predator–prey dynamics, symbiosis, and resource partitioning in relation to population stability.
- Assess the influence of group behaviors on survival and reproduction within species.
- Use evidence to explain how ecosystems maintain stability or shift under changing conditions, including human impacts.

Priority Standards:
3.1.9-12.H: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.
3.1.9-12.I: Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.
3.1.9-12.L: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. Assessment Boundary: Assessment is limited to provided data.
3.1.9-12.M: 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. Assessment Boundary: N/A
3.1.9-12.N: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity. Assessment Boundary: N/A
3.3.9-12.O: Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. Assessment Boundary: N/A

Supporting Standards:
CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

Acceptable Evidence:

Performance Tasks:

- Scientific Writing
- Problem Solving Activities
- Real-world Application
- Laboratory/Safety Skills

Acceptable Evidence of Learning other than Performance Tasks:

- Mastery Checks
  - Critical Thinking Questions
  - Summary of Key Concepts

Formative Assessment:

- Learning Checks
  - Warm-ups
  - Closure/ Exit Tickets
  - Open ended responses

Summative Assessment:

- Section Assessments (Quiz)
- Project based learning opportunities
- District Common Unit Summative Assessment
  - Multiple Choice and Free Response
    - Scientific inquiry questions

Suggested Learning Experiences and Instruction

Learning Experiences:

Energy, Matter, and Ecosystem Dynamics - Students will:

- Examine the interactions among Earth's spheres (geosphere, hydrosphere, atmosphere, biosphere) and analyze how energy from the Sun drives ecosystem processes.
- Examine Ecosystems to explore biotic and abiotic factors.
- Evaluate Greenhouse effect to understand the role of greenhouse gases in Earth's energy balance, and exploring human activities (fossil fuels, deforestation) that enhance this natural process.
- Construct and interpret food chains, food webs, and energy pyramids to model energy flow and trophic interactions in ecosystems.
- Analyze energy transfer efficiency and its effect on ecosystem productivity and population size.
- Model and represent the cycling of matter (carbon, nitrogen, water, phosphorus) and describe its role in ecosystem stability.
- Collect and analyze data to understand how biotic and abiotic components support ecosystem structure.

Biodiversity and Ecosystem Stability - Students will:

- Explore patterns of biodiversity at the genetic, species, and ecosystem levels and evaluate how biodiversity contributes to ecosystem resilience and stability.
- Measure and quantify biodiversity using sampling methods and data analysis.
- Investigate the roles of species within ecosystems, including keystone and invasive species, and assess their impact on ecosystem structure and function.
- Analyze how changes in biodiversity influence ecosystem stability and nutrient cycling.
- Apply conservation and sustainability principles to propose strategies that maintain biodiversity and ecosystem health.

Population Dynamics, Species Interactions, and Human Impacts - Students will:

- Examine factors influencing population size, growth, and regulation, including resource availability, environmental conditions, and species interactions.
- Analyze different types of species interactions, such as competition, symbiosis, predator–prey relationships, and resource partitioning, and determine their effects on ecosystem stability.
- Explore ecological succession and predict changes in ecosystems over time following disturbances.
- Develop and interpret population growth models (exponential and logistic) to assess carrying capacity and limiting factors.
- Evaluate human impacts on populations and ecosystems and explore strategies for conservation, restoration, and sustainable ecosystem management.

Instructional Strategies: Instruction in this unit is anchored in real-world phenomena and case studies and uses the 5E learning cycle.

Energy, Matter, and Ecosystem Dynamics

- Engage: Introduce phenomena such as ecosystem productivity or disruptions in food webs to prompt questions about energy flow and system interactions.
- Explore: Students model food chains, food webs, and energy pyramids, and investigate matter cycling (carbon, nitrogen, water, phosphorus) using data and simulations.
- Explain: Students construct explanations of energy flow, matter cycling, and system interactions. Direct instruction clarifies trophic relationships, energy transfer efficiency, and the role of biotic and abiotic factors.
- Honors Level - Elaborate: Students apply models to new scenarios, analyze ecosystem data, and explain how changes in one component affect system stability.

Biodiversity and Ecosystem Stability

- Engage: Present phenomena such as species loss or changes in biodiversity to generate questions about ecosystem stability.
- Explore: Students measure biodiversity using sampling methods and analyze the roles of species, including keystone and invasive species.
- Explain: Students explain how biodiversity contributes to ecosystem resilience. Direct instruction supports understanding of biodiversity levels and ecosystem function.
- Honors Level - Elaborate: Students evaluate the impacts of biodiversity changes and propose conservation strategies to maintain ecosystem health.

Population Dynamics and Species Interactions

- Engage: Use phenomena such as population fluctuations or predator–prey relationships to prompt questions about population change.
- Explore: Students develop and interpret population models and investigate species interactions, including competition, symbiosis, and succession.
- Explain: Students explain factors affecting population growth and ecosystem stability. Direct instruction clarifies population models, carrying capacity, and interaction types.
- Honors Level - Elaborate: Students apply models to predict population changes under different conditions and evaluate human impacts on ecosystems.

Differentiation: Intervention/Enrichment Options: Instruction is differentiated through scaffolded modeling, data analysis, and investigation tasks to support all learners.

Intervention:

- Scaffold learning through vocabulary support, graphic organizers, guided investigations, visual models, and simulations of ecological systems.
- Provide structured data analysis, small-group instruction, and frequent formative feedback to support understanding of ecosystem interactions and population dynamics.

- Use modified datasets, worked examples, and flexible supports to strengthen interpretation of ecological models and environmental data.

Enrichment

- Extend learning through advanced data analysis, quantitative population and ecosystem modeling, student-designed investigations, and independent research.
- Apply ecological concepts to authentic environmental issues, conservation challenges, and sustainability initiatives.
- Evaluate scientific claims, interpret complex datasets, and use evidence to propose solutions to ecological and environmental problems.

For Language Development:

- Create a student-made dictionary that includes terms, definitions, and examples organized by chapter.
- Teach only essential vocabulary (as indicated in knowledge section).
- Pre-teach vocabulary or have the ELD teacher pre-teach it if possible.

Desired Results:

Essential Questions:

- How do humans depend on and impact Earth's systems?
- How do natural resources, hazards, and climate influence human systems?
- How do tradeoffs shape decisions about resource use and sustainability?
- How do environmental changes affect ecosystems and human societies?

Enduring Understandings:

Students will understand that…

- As the environment and populations of species change, there are resulting changes in ecosystems.
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things.
- All materials, energy, and fuels that humans use are derived from natural sources, some of which are renewable and others are not.
- Natural processes can cause sudden or gradual changes to Earth's systems that may impact human societies.
- Human activities in agriculture, industry, and everyday life impact land, water, and air systems.
- Sustainability requires responsible resource management informed by data, best practices, and policy decisions.

Knowledge:

Students will know...

- Current climate models predict increasing global temperatures influenced by greenhouse gas emissions and interactions among Earth systems.
- Interactions among the atmosphere, hydrosphere, and biosphere are modified by human activity and can be studied using simulations and models.
- Resource availability has shaped the development of human societies.
- Natural hazards and geologic processes impact human populations and migration patterns.
- Resource extraction and energy production involve tradeoffs, including economic, environmental, and social costs and benefits.
- Sustainability requires evaluating constraints such as cost, safety, reliability, and environmental impact.
- Human activities can disrupt ecosystems and biodiversity through pollution, habitat destruction, overexploitation, invasive species, and climate change.
- Maintaining biodiversity is essential for ecosystem stability and human well-being.

Skills:

Students will be able to…

- Categorize and analyze relationships between human systems and Earth systems
- Analyze data and models to explain the impacts of human activity on Earth systems
- Evaluate tradeoffs of resource use and sustainability decisions using evidence
- Interpret how natural hazards and climate patterns influence human systems
- Construct evidence-based explanations about sustainability and environmental impacts

Priority Standards:

3.3.9-12.M: Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.
3.3.9-12.O: 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. Assessment Boundary: N/A

3.3.9-12.P: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. Assessment Boundary: N/A
3.3.9-12.R: Evaluate or refine a technological solution that reduces the impact of human activities on natural systems.
3.4.9-12.C: Analyze and interpret how issues, trends, technologies, and policies impact watershed and water resources.
3.4.9-12.G: Analyze and evaluate how best resource management practices and environmental laws achieve sustainability of natural resources

Supporting Standards:
CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
CC.3.5.9-10.G: Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
CC.3.5.9-10.H: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
CC.3.6.9-12.F: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Acceptable Evidence:

Performance Tasks:
- Scientific Writing
- Problem Solving Activities
- Real-world Application
- Laboratory/Safety Skills

Acceptable Evidence of Learning other than Performance Tasks:
- Mastery Checks
    - Critical Thinking Questions
    - Summary of Key Concepts

Formative Assessment:
- Learning Checks
    - Warm-ups
    - Closure/ Exit Tickets
    - Open ended responses

Summative Assessment:
- Section Assessments (Quiz)
- Project based learning opportunities
- District Common Unit Summative Assessment
    - Multiple Choice and Free Response
        - Scientific inquiry questions

Suggested Learning Experiences and Instruction

Learning Experiences:
Human Dependence on and Use of Resources - Students will:
- Examine how humans depend on natural resources for energy, materials, food, and water.
- Analyze how resource availability has shaped the development of human societies.
- Evaluate renewable and nonrenewable resource use, including benefits, limitations, and long-term impacts.
- Investigate how resource extraction and energy production impact Earth systems.

Climate, Hazards, and Earth System Interactions - Students will:

- Analyze climate data and models to identify trends and explain changes in global and regional systems.
- Investigate how interactions among the atmosphere, hydrosphere, and biosphere are influenced by human activity.
- Examine natural hazards and their impacts on human populations and the environment.
- Analyze how weather, climate, and environmental changes influence human systems and decision-making.

Human Impacts on Ecosystems and Biodiversity - Students will:

- Analyze how human activities impact ecosystems through pollution, habitat destruction, overexploitation, and climate change.
- Evaluate how changes in biodiversity affect ecosystem stability and human systems.
- Examine case studies to identify patterns in environmental change and system interactions.
- Investigate how human actions can disrupt or support ecosystem processes.

Sustainability and Environmental Decision - Students will:

- Evaluate sustainable practices in agriculture, water use, and resource management.
- Analyze environmental policies and economic systems used to address environmental challenges.
- Evaluate tradeoffs among environmental, economic, and social factors in sustainability decisions.
- Use evidence to assess and compare solutions that promote sustainable resource use and environmental stewardship.

Instructional Strategies: Instruction in this unit is anchored in real-world phenomena and case studies and uses the 5E learning cycle.

Human Dependence on and Use of Resources

- Engage: Introduce phenomena such as resource demand or sustainability initiatives (e.g., Greening of American Schools) to prompt questions about human dependence on Earth systems.
- Explore: Students analyze data on resource use, energy production, and resource availability, including examples from agricultural and energy systems.
- Explain: Students explain how human societies depend on natural resources and how resource use impacts Earth systems. Direct instruction clarifies resource types, availability, and tradeoffs.
- Honors Level - Elaborate: Students evaluate resource management strategies using case studies (e.g., global sustainability comparisons such as the U.S. and China).

Climate, Hazards, and Earth System Interactions

- Engage: Use phenomena such as climate trends or glacial melting (e.g., Melting Ice in Greenland) to generate questions about system interactions.
- Explore: Students analyze climate data, investigate hazards, and examine system interactions influenced by human activity.
- Explain: Students explain how climate and natural processes influence human systems. Direct instruction clarifies climate drivers, feedbacks, and Earth system interactions.
- Honors Level - Elaborate: Students analyze how changes in climate systems affect human populations, agriculture, and resource availability.

Human Impacts on Ecosystems and Biodiversity

- Engage: Present phenomena such as ecosystem change or food system innovation (e.g., Growing Power: An Urban Food Oasis) to prompt inquiry.
- Explore: Students analyze case studies and data related to human impacts on ecosystems, including land use, agriculture, and resource extraction.
- Explain: Students explain how human activities impact biodiversity and ecosystem stability. Direct instruction clarifies key impact mechanisms and system responses.
- Honors Level - Elaborate: Students evaluate strategies for conservation, sustainable agriculture, and ecosystem management.

Sustainability and Environmental Decision-Making

- Engage: Introduce decision-making scenarios and case studies (e.g., Colorado River Study, global sustainability comparisons) to frame real-world problems.

- Explore: Students investigate sustainability practices, policies, and economic tools used to address environmental challenges.
- Explain: Students explain how tradeoffs influence environmental decisions. Direct instruction clarifies cost-benefit analysis, policy, and sustainability frameworks.
- Honors Level - Elaborate: Students evaluate and compare solutions to environmental problems using evidence and defined criteria.

Differentiation: Intervention/Enrichment Options: Instruction is differentiated through scaffolded modeling, data analysis, and investigation tasks to support all learners.

Intervention:

- Scaffold content through vocabulary support, guided notes, graphic organizers, and models.
- Provide structured investigations, teacher-guided data analysis, and frequent formative feedback.
- Use simulations, visuals, modified datasets, and flexible pacing to support understanding.

Enrichment:

- Extend learning through independent research, student-designed investigations, and analysis of additional datasets.
- Apply advanced quantitative models, digital simulations, and evidence-based evaluation of scientific claims.
- Connect to policy, engineering, sustainability, climate forecasting/scenario analysis.

For Language Development:

- Create a student-made dictionary that includes terms, definitions, and examples organized by chapter.
- Teach only essential vocabulary (as indicated in knowledge section).
- Pre-teach vocabulary or have the ELD teacher pre-teach it if possible.

Desired Results:

Essential Questions:

- How can investigating local environmental issues lead to informed solutions?
- How do human actions and policies affect sustainability and environmental equity?
- How can evidence be used to propose and justify solutions to environmental problems?

Enduring Understandings:

Students will understand that…

- Environmental literacy requires applying scientific knowledge to real-world problems and decisions.
- Investigation of local environmental issues can inform broader regional and global understanding.
- Sustainable solutions require balancing environmental, social, and economic considerations.
- Data-driven decision-making supports responsible environmental stewardship and policy development.
- Environmental justice and equity influence access to resources and exposure to environmental risks.

Knowledge:

Students will know…

- Scientific understanding of Earth systems, ecosystems, and human impacts developed in Units 1–3
- Methods for investigating environmental issues, including data collection, modeling, and research
- Principles of sustainability, environmental policy, and decision-making frameworks
- How multiple perspectives, including social and cultural factors, influence environmental decisions

Skills:

Students will be able to…

- Plan and conduct an investigation of a local environmental issue
- Gather, evaluate, and synthesize information from multiple sources
- Analyze quantitative and qualitative data to identify patterns and relationships
- Develop and justify evidence-based solutions to environmental problems
- Evaluate solutions using criteria such as cost, impact, and equity
- Communicate findings and recommendations clearly through written, visual, or oral formats
- Apply systems thinking to explain complexity and predict unintended consequences

Priority Standards:

3.3.9-12.Q: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations. Assessment Boundary: N/A

3.4.9-12.A: Analyze and interpret how issues, trends, technologies, and policies impact agricultural, food, and environmental systems and resources

3.4.9-12.B: Apply research and analytical skills to evaluate the conditions and motivations that lead to conflict, cooperation, and change among individuals, groups, and nations.

3.4.9-12.C: Analyze and interpret how issues, trends, technologies, and policies impact watershed and water resources.

3.4.9-12.D: Apply research and analytical skills to systematically investigate environmental issues ranging from local issues to those that are regional or global in scope.

3.4.9-12.E: Plan and conduct an investigation utilizing environmental data about a local environmental issue.

3.4.9-12.F: Evaluate and communicate the effect of integrated pest management practices on indoor and outdoor environments.

3.4.9-12.G: Analyze and evaluate how best resource management practices and environmental laws achieve sustainability of natural resources
3.4.9-12.H: Design and evaluate solutions in which individuals and societies can promote stewardship in environmental quality and community well-being.
3.4.9-12.I: Analyze and interpret data on regional environmental conditions and its implications on environmental justice and social equity.

Supporting Standards:
CC.3.5.9-12.A: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
CC.3.6.9-12.B: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
CC.3.6.9-12.H: Draw evidence from informational texts to support analysis, reflection, and research.

Acceptable Evidence:

Performance Tasks:

- Scientific Writing
- Problem Solving Activities
- Real-world Application

Formative Assessment:

- Learning Checks
    - Warm-ups
    - Closure/ Exit Tickets

Summative Assessment:

- Environmental Literacy and Action Capstone Project- District Common Unit Summative Assessment

Suggested Learning Experiences and Instruction

Learning Experiences:
Students will:

- Identify and investigate a local environmental issue connected to Earth systems, ecosystems, and human impacts.
- Develop and refine research questions to guide investigation of environmental problems and their causes.
- Gather, evaluate, and synthesize information from multiple credible sources, including scientific data, case studies, and policy perspectives.
- Analyze quantitative and qualitative data to identify patterns, relationships, and system interactions.
- Apply systems thinking to explain how environmental, social, and economic factors interact within the issue.
- Evaluate how human actions, policies, and resource use influence environmental outcomes and equity.
- Develop evidence-based solutions that address the environmental issue and consider sustainability and feasibility.
- Evaluate tradeoffs among environmental, economic, and social factors when comparing potential solutions.
- Communicate findings and recommendations using data, models, and evidence to support claims.
- Justify proposed solutions using scientific reasoning, sustainability principles, and consideration of multiple perspectives.

Instructional Strategies: Instruction in this unit is grounded in project-based, phenomena-driven learning and structured using the 5E Learning Cycle to support investigation, analysis, and application of environmental literacy.

- Engage: Students are introduced to local or regional environmental issues and relevant examples to generate questions and define a focus for investigation.
- Explore: Students conduct research, gather and analyze data, and investigate the causes, impacts, and systems associated with the issue using multiple sources and methods.

- Explain: Students construct evidence-based explanations of the issue and its underlying system interactions. Direct instruction supports research methods, data analysis, systems thinking, and environmental policy concepts.
- Honors Level - Elaborate: Students extend their understanding by evaluating potential solutions, analyzing tradeoffs, and refining proposals based on environmental, economic, and social criteria.

Differentiation: Intervention/Enrichment Options: Instruction is differentiated through scaffolded modeling, data analysis, and investigation tasks to support all learners.

Intervention:

- Scaffold learning through vocabulary support, graphic organizers, guided research and investigations, structured data analysis, and teacher feedback.
- Provide small-group instruction, curated resources, project checkpoints, and flexible supports to strengthen scientific reasoning, systems thinking, and communication skills.

Enrichment:

- Extend learning through advanced data analysis, independent research, systems modeling, and evidence-based evaluation of environmental issues and solutions.
- Apply learning to authentic environmental challenges through solution design, stakeholder analysis, and communication of recommendations.

For Language Development:

- Create a student-made dictionary that includes terms, definitions, and examples organized by chapter.
- Teach only essential vocabulary (as indicated in knowledge section).
- Pre-teach vocabulary or have the ELD teacher pre-teach it if possible.