Grade 12

Environmental Science

SC660 - 1 credit

Connecticut Technical High School System
39 Woodland Street
Hartford, Connecticut 06105

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CTECS - Vision of a Graduate

The Vision of a Graduate (VoG) at the Connecticut Technical Education and Career System (CTECS) embodies our commitment to preparing students for success in Connecticut's workforce.

Developed in collaboration with students, parents, staff, and employers, the VoG ensures that CTECS students are not only job-ready but also equipped to lead, innovate, and adapt in a dynamic world.

As educators, we are dedicated to developing these qualities by providing a comprehensive education that empowers our students to achieve their fullest potential and make meaningful contributions to society

A Problem Solver

Problem solvers tackle challenges by identifying root causes of issues, brainstorming solutions, implementing effective strategies, and demonstrating adaptability.

- ➔ Engage students with open-ended, creative thinking tasks that require both conventional and innovative solutions.
- ➔ Facilitate group discussions and collaborative projects.
- ➔ Use real-world scenarios and hands-on activities.
- ➔ Highlight the importance of effort, persistence, and continuous learning.
- ➔ Provide regular feedback and encourage reflection.

Work Ready

To be work-ready includes a combination of technical expertise, soft skills, and personal qualities that ensure a graduate can effectively contribute to the workplace from day one.

- ➔ Set high standards for punctuality, responsibility, professionalism, and task completion.
- ➔ Use project-based learning and collaborative assignments.
- ➔ Emphasize clear written and verbal communication.
- ➔ Offer practical exercises like mock interviews and resume workshops.
- ➔ Integrate technology and teach digital literacy.

Respectful

Graduates who embody respectfulness emphasize the importance of treating others with dignity, valuing diversity, and fostering an inclusive and positive environment, both personally and professionally.

- ➔ Demonstrate personal, interpersonal, and professional skills.
- ➔ Show respect for diversity.
- ➔ Model respect through active listening and empathy.
- ➔ Set clear expectations for respectful interactions.
- ➔ Promote collaboration and group discussions.
- ➔ Celebrate respectful behavior.
- ➔ Address disrespect promptly and constructively.

Skilled Socially

Graduates who are skilled socially are equipped to navigate social environments, build relationships, and contribute positively to their communities and workplaces.

- ➔ Show awareness of global responsibility to others and the environment.
- ➔ Participate in community involvement.
- ➔ Design cooperative group projects and team activities
- ➔ Set expectations for respect and give regular feedback.
- ➔ Facilitate discussions on inclusivity, kindness, and respect.
- ➔ Model positive interactions and recognize strong social skills.

A Critical Thinker

Critical thinkers approach problems systematically by analyzing, evaluating, and synthesizing information to make well-informed decisions and contribute to innovative solutions.

- ➔ Encourage critical thinking individually and collaboratively.
- ➔ Design lessons that challenge assumptions and explore diverse viewpoints.
- ➔ Use open-ended questions, rigorous activities, and cross-curricular projects.
- ➔ Integrate project-based learning and real-world problem-solving.
- ➔ Offer reflective opportunities like journaling and discussions.
- ➔ Cultivate an environment that values curiosity and inquiry.

An Effective Communicator

Effective communicators convey ideas, information, and emotions accurately and persuasively, fostering understanding and collaboration.

- ➔ Communicate effectively using oral, written, visual, artistic, and technical modes.
- ➔ Include group discussions, presentations, and peer reviews.
- ➔ Promote active listening and thoughtful responses.
- ➔ Offer clear guidelines and constructive feedback.
- ➔ Stress clear, respectful, and purposeful communication.

CTECS Instructional Model

CTECS uses the Marzano Compendium to guide research-based instructional strategies that differentiate learning and promote access, engagement, and success for all students. Teachers apply these strategies to support diverse learners (including multilingual learners, students with disabilities, and students with varied academic or technical backgrounds) through scaffolds, modeling, guided practice, and multiple ways to participate and show understanding. This approach ensures every student can work toward proficiency in the Priority Standards and the competencies outlined in the CTECS Vision of a Graduate.

Curriculum Introduction

This curriculum document outlines the essential learning for this academic program and provides a clear structure for planning, instruction, and assessment. It includes the components required by NEASC Standard 2.2a, along with elements that reflect the unique nature of CTECS academic programs. The curriculum is organized to show what students learn in each course, how learning progresses across grade levels, and how instruction supports both technical skill development and the CTECS Vision of a Graduate.

Teachers should use this document to:

- Understand the overall structure and expectations of the course sequence
- Reference the Course Map to see the scope and sequence of Priority Standards
- Use the Priority Standards and Units of Study to guide daily, weekly, and cycle-based planning
- Integrate Big Ideas, Essential Questions, Skills/Learning Outcomes, vocabulary, and resources during lesson design
- Plan and implement formative assessments to monitor progress and guide instruction
- Prepare students for the District Summative Assessments, ensuring alignment with the Course Map
- Maintain consistency of instruction across campuses while adapting to student needs

Curriculum Components

Course Map

A Course Map serves as the scope and sequence for this course by outlining the progression of instructional units and the standards that guide teaching and assessment. While each campus will have individual student needs, cycle schedules, and industry-based opportunities, all instructors are expected to teach the standards outlined in the Course Map. Using the Course Map below, teachers will intentionally plan learning experiences that prepare students to meet the identified standards within the designated assessment windows.

Priority Standards (Units of Study)

Priority Standards identify the most essential learning in the trade program. They reflect the core technical competencies, safety practices, and industry-aligned skills that require the greatest instructional focus and appear on program assessments. In CTE programs, each Priority Standard also functions as a Unit of Study, because it includes the required components such as big ideas, essential questions, content topics, and skills/learning outcomes aligned to assessments.

Learning Outcomes

Learning outcomes are what students will know (Concepts) and be able to do (Skills). Concepts identify the major content topics within the Priority Standard (Unit of Study). They appear in the left column of the Learning Outcomes table and follow a similar coding structure as the Priority Standard. Skills are learning objectives that describe the measurable actions students must be able to perform to demonstrate proficiency.They appear in the right column of the Learning Outcomes table and show the progression of learning evidence in the Priority Standard.

Resources

Resources include the tools, equipment, texts, materials, and digital tools that support learning within each unit and reflect industry standards.

Assessment Practices

Teachers use ongoing formative assessments—such as questioning, checks for understanding, performance demonstrations, reflections, and teacher observation—to monitor progress, guide instruction, and support all learners in mastering the Priority Standards.

Vocabulary

Essential vocabulary includes the technical and academic terms students must understand and use accurately to engage in scientific learning and demonstrate proficiency on assessments. Vocabulary is foundational to safety, precision, and communication, and should be a primary initial focus within each unit and taught explicitly through modeling, demonstration, and repeated application.

Environmental Science Philosophy

The Environmental Science course is an interdisciplinary program designed to help students explore the complex intersections of Life, Physical, and Earth Sciences as they relate to the natural world. This academic curriculum ensures students develop an in-depth understanding of scientific content while building essential skills such as communication, collaboration, inquiry, problem solving, and flexibility that are central to their educational and professional lives.

Aligned with the Next Generation Science Standards (NGSS), the program engages students in Scientific and Engineering Practices and Crosscutting Concepts to investigate the relationships between human activity and the environment. Students gain rigorous academic and practical experience through hands-on laboratory and engineering activities, technology-based inquiry, and the active collection, analysis, and interpretation of student-generated data.

In accordance with NGSS philosophy, instruction is driven by observable phenomena and student-generated questions, challenging learners to use scientific knowledge to explain or predict real-world events. By exploring specialized fields such as ecosystem dynamics, biodiversity, renewable energy, and global sustainability, students prepare for a successful transition to post-secondary education or professional careers as work-ready graduates in Connecticut's workforce.

INSTRUCTIONAL CONSIDERATIONS

<u>Anchoring Phenomena</u>: In accordance with NGSS philosophy, instructors will ***use observable phenomena and student-generated questions to drive instruction***. Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict; they are the context for the work of both the scientist and the engineer. The point of using phenomena to drive instruction is to help ALL students engage in practices to develop the knowledge necessary to explain or predict phenomena. Effective instruction, therefore, results in students being able to explain carefully selected and relevant phenomena by developing and applying the Learning Outcomes and crosscutting concepts (CCCs) through the use of the science and engineering practices (SEPs).

Environmental Science - Course Map

Semester 1

- Unit 1: Foundations of Environmental Science & Ecosystems
  - Priority Standard 1: Sustainability, Economics, and Environmental Policy
  - Priority Standard 2: Ecosystem Dynamics and Evolutionary Adaptation
- Unit 2: Energy Flow and Global Climate Systems
  - Priority Standard 3: Trophic Energy Flow and Biogeochemical Cycling
  - Priority Standard 4: Climate and Terrestrial Biome Distribution
  - Priority Standard 5: Population Ecology and Species Interactions

Semester 2

- Unit 3: Population Dynamics and Water Management
  - Priority Standard 6: Human Population Trends and Transitions
  - Priority Standard 7: Human Population Trends and Transitions
  - Priority Standard 8: Aquatic Systems and Freshwater Resource Management
- Unit 4: Land Use, Energy, and Environmental Health
  - Priority Standard 9: Land Use, Biodiversity, and Conservation
  - Priority Standard 10: Energy Systems and Environmental Toxicology

***Suggested pacing includes one standard per academic cycle**.

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Unit 1: Foundations of Environmental Science & Ecosystems

Unit 1 Anchoring Phenomena: The "Tragedy of the Commons" and the development of pesticide resistance in insect populations.

Priority Standard 1: Sustainability, Economics, and Environmental Policy

Big Idea(s):
- Sustainability is the central goal of environmental science, requiring a balance between resource use and future availability.
- Environmental problem-solving necessitates value judgments based on scientific facts and economic realities

Essential Question(s):
- How do the economic principles of the "Tragedy of the Commons" influence modern environmental policy?
- To what extent can an individual's ecological footprint predict the sustainability of a nation?

Learning Outcomes

Students will know:	As evidenced by:
1.1 Major Contributing Fields 1.2 Resource Classifications 1.3 Tragedy of the Commons Principles 1.4 Ecological Footprint Utility 1.5 Environmental Impact Comparisons 1.6 Historical Revolutions 1.7 Economic Management Roles 1.8 Environmental Impact Statement (EIS) Purposes 1.9 Federal Agency Functions	• Identify the roles of Biology, Earth Science, Physics, Chemistry, and Social Sciences in solving environmental issues. • Categorize provided materials as Renewable or Non-renewable resources. • Evaluate real-world scenarios using the principles of the Tragedy of the Commons. • Apply the ecological footprint utility to interpret nation-specific sustainability data. • Compare various forms of environmental impact. • Contrast the environmental footprints of the Agricultural vs. Industrial Revolutions. • Analyze the role of economics in resource management and policy. • Explain the purpose and legal requirements of an EIS. • Distinguish between the specific functions of the Environmental Protection Agency (EPA) and the National Park Service (NPS)

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Vocabulary: Sustainability, Ecological Footprint, Renewable/Non-renewable, EIS, Tragedy of the Commons
Resources: Global Footprint Network, Edpuzzle (The Commons), EPA.gov (Policy) **SEP and CCC Connections:** SEPs: Analyzing and Interpreting Data (evaluating nation-specific ecological footprint data); Developing and Using Models (constructing a coastal wind model); Obtaining, Evaluating, and Communicating Information (designing news articles or brochures on environmental issues). CCCs: Stability and Change (sustainability as a balance of resource use); Influence of Science, Engineering, and Technology on Society and the Natural World

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Priority Standard 2: Ecosystem Dynamics and Evolutionary Adaptation

Big Idea(s):
- Ecosystem stability is maintained through the complex interactions of biotic and abiotic factors.
- Natural selection is the mechanism through which populations adapt to environmental pressures over time

Essential Question(s):
- How does natural selection drive the development of resistance in a population?.
- Why is the interdependence of different kingdoms of life (e.g., angiosperms and animals) vital for ecosystem survival?

Learning Outcomes

Students will know:	As evidenced by:
2.1 Habitat Factors 2.2 Population and Species Distinctions 2.3 Natural Selection Mechanisms 2.4 Physiological Adaptation Concepts 2.5 Pesticide Resistance Development 2.6 Six Kingdoms of Life Characteristics 2.8 Ecological Importance of Microorganisms 2.9 Angiosperm and Animal Interdependence	• Distinguish between Biotic and Abiotic factors in a local ecosystem. • Differentiate between populations and species. • Illustrate the mechanisms of evolution through natural selection examples. • Identify examples of physiological adaptation. • Analyze the development of pesticide resistance in insect populations. • Identify organisms based on the Six Kingdoms of Life characteristics. • Evaluate the ecological importance of Bacteria, Fungi, and Protists. • Describe the mutualistic relationship between Angiosperms and Animals. • Evaluate the use of the pebble mark-recapture method via lab survey data. • Design and conduct an experiment to calculate temperature effects on seed germination. • Demonstrate examples of both artificial and natural selection. • Interpret changes within a small closed system over time. • Evaluate the consumer value of various selected species.

Vocabulary: Abiotic, Biotic, Natural Selection, Adaptation, Pesticide Resistance

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Resources: HHMI BioInteractive (Evolution), Gizmos (Natural Selection), Field Guides

SEP and CCC Connections:
SEPs: Planning and Carrying Out Investigations (designing experiments on seed germination); Analyzing and Interpreting Data (evaluating mark-recapture lab data).
CCCs: Stability and Change (maintenance of ecosystem stability); Cause and Effect (natural selection driving adaptation)

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Unit 2: Energy Flow and Global Climate Systems

Unit 2 Anchoring Phenomena: The impact of fertilizers on aquatic stability and the predicted environmental effects of a "warmer Earth" scenario.

Priority Standard 3: Trophic Energy Flow and Biogeochemical Cycling

Big Idea(s):
- Energy flows unidirectionally through food webs, losing efficiency at each trophic level.
- Biogeochemical cycles (carbon, nitrogen, phosphorus) are essential for the continuous reuse of matter in the biosphere

Essential Question(s):
- How does the structure of an energy pyramid explain the limitation of top-tier consumers?.
- How do human disruptions to the nitrogen and phosphorus cycles (e.g., fertilizers) impact aquatic stability?

Learning Outcomes

Students will know:	As evidenced by:
3.1 Energy Transfer Mechanisms 3.2 Trophic Levels and Pyramid Structure 3.3 Photosynthesis Process and Importance 3.4 Carbon Cycle Processes 3.5 Nitrogen Cycle Stages 3.6 Phosphorus Cycle and Fertilizer Effects 3.7 Ecological Succession Types 3.8 Pioneer Species and Lichen Roles	• Identify energy transfer mechanisms from producers to consumers. • Construct an Energy Pyramid to illustrate loss of efficiency between trophic levels. • Explain the process and importance of photosynthesis. • Diagram Short-term vs. Long-term carbon processes. • Identify the biological and chemical changes in the Three Stages of the Nitrogen Cycle. • Analyze the impact of excess fertilizer on the phosphorus cycle. • Differentiate between Primary and Secondary succession. • Evaluate the function of Lichens in early soil formation. • Interpret carbon dioxide changes by calculating pH shifts in closed systems. • Evaluate the effects of biological magnification on birds of prey. • Analyze the process of fermentation relative to the carbon cycle. • Construct a map identifying neighborhood areas where succession is occurring.

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	• Demonstrate dependency patterns between consumers and producers.
Vocabulary: Biome, Latitude, Greenhouse Effect, Stratosphere, Feedback Loop	
Resources: NASA Climate Vital Signs, Gizmos (Greenhouse Effect), Google Earth **SEP and CCC Connections:** SEPs: Analyzing and Interpreting Data (interpreting pH shifts in closed systems); Developing and Using Models (constructing maps of local succession). CCCs: Energy and Matter (unidirectional energy flow and the continuous reuse of matter in cycles)	

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Priority Standard 4: Climate and Terrestrial Biome Distribution

Big Idea(s):
- Terrestrial biomes are determined primarily by the climatic interplay of temperature and precipitation

Essential Question(s):
- How do variations in latitude and altitude dictate the physiological adaptations of organisms?

Learning Outcomes

Students will know:	As evidenced by:
4.1 Plant Growth Determinants 4.2 Latitude and Altitude Effects 4.3 Tropical Rainforest Zonation 4.4 Temperate Deciduous Forest Adaptations 4.5 Taiga and Desert Animal Adaptations 4.6 Chaparral Climatic Characteristics 4.7 Global Biome Threats	• Assess the effects of temperature, precipitation, latitude, and altitude on vegetation growth. • Identify the vertical layers of a rainforest. • Review adaptations in temperate deciduous forest plants. • Compare specific animal adaptations required for survival in various biomes. • Profile the climatic characteristics of the Chaparral biome. • Assess the primary human threats to the Tundra and Rainforest. • Demonstrate the effects of mechanical and chemical weathering on rock samples. • Evaluate the relationship between weathering processes and soil formation. • Interpret the ecological roles of organisms within a temperate deciduous forest. • Analyze the differences between tropical and temperate grasslands. • Construct a presentation investigating specific adaptations of desert animals.

Vocabulary: Biome, Latitude, Altitude, Stratification, Weathering

Resources: Google Earth (Biome Tours), Gizmos (Pond Ecosystem)

SEP and CCC Connections:
SEPs: Planning and Carrying Out Investigations (demonstrating weathering on rock samples); Obtaining, Evaluating, and Communicating Information (investigating desert animal adaptations).
CCCs: Patterns (latitude and altitude dictating biome distribution); Structure and Function (physiological adaptations of organisms).

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Priority Standard 5: Population Ecology and Species Interactions

Big Idea(s):
- Populations are regulated by density-dependent and density-independent limiting factors.
- Species interactions (symbiosis, predation, competition) define an organism's niche

Essential Question(s):
- How do ecologists use dispersion and density to predict future population changes?.
- How does the evolution of symbiotic relationships promote ecosystem resilience?

Learning Outcomes

Students will know:	As evidenced by:
5.1 Atmospheric Circulation and Microclimates 5.2 Atmospheric Removal Processes 5.3 Global Temperature Feedback Cycles 5.4 Greenhouse Gas Concentrations 5.5 UV Radiation Effects 5.6 Stratospheric Ozone Shielding 5.7 "Warmer Earth" Environmental Predictions	• Identify mechanisms of atmospheric circulation and microclimates. • Map the four major processes that remove materials from the atmosphere. • Identify examples of Positive and Negative feedback cycles on temperature. • Calculate greenhouse gas concentrations using PPM vs. PPB units. • Evaluate the damaging effects of ultraviolet (UV) radiation. • Review the shielding function of stratospheric ozone. • Interpret atmospheric data to evaluate the predicted effects of global warming. • Evaluate economic and environmental opposition to fossil fuel reduction. • Analyze methane production in ruminant animals and its atmospheric impact. • Demonstrate possible solutions to reduce greenhouse gas concentrations. • Evaluate the ongoing threats to the ozone layer despite regulations.

Vocabulary: Carrying Capacity, Niche, Symbiosis, Commensalism, Parasitism

Resources: Gizmos (Rabbit Population), Edpuzzle (Population Ecology)

SEP and CCC Connections:
SEPs: Analyzing and Interpreting Data (evaluating atmospheric data and global warming effects); Constructing Explanations and Designing Solutions (designing solutions to reduce greenhouse gases).
CCCs: Systems and System Models (atmospheric circulation and microclimates); Cause and Effect (feedback cycles and global temperature).

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Unit 3: Population Dynamics and Water Management

Unit 3 Anchoring Phenomena: Human population growth trends and the remediating of groundwater vs. surface water pollution

<table>
<tr><td colspan="2">Priority Standard 6: Human Population Trends and Transitions</td></tr>
<tr><td colspan="2">Big Idea(s):
The human population has experienced unprecedented growth in the last 200 years, altering global resource needs.
The demographic transition model explains why birth and death rates vary between developed and developing nations</td></tr>
<tr><td colspan="2">Essential Question(s):
How do age structure diagrams allow scientists to predict a country's future environmental impact?.
What are the primary social and economic problems caused by rapid human population growth?</td></tr>
<tr><td colspan="2" align="center">Learning Outcomes</td></tr>
<tr><td align="center">Students will know:</td><td align="center">As evidenced by:</td></tr>
<tr><td>6.1 Population Properties

6.2 Growth Patterns

6.3 Natural Regulation Factors

6.4 Limiting Factors

6.5 Niche and Habitat Distinctions

6.6 Species Interaction Types

6.7 Parasitism and Predation Differences

6.8 Symbiotic Relationship Evolution</td><td>Measure population Density, Dispersion, and Size.
Distinguish between Exponential and Logistic growth curves.
Identify mechanisms for the natural regulation of population sizes.
Categorize Density-independent and Density-dependent limiting factors.
Differentiate between Niche and Habitat.
Categorize the five major types of species interactions.
Compare the differences between parasitism and predation.
Analyze the evolution of symbiotic relationships.
Design a model to calculate the limiting factors for a specific ecosystem.
Evaluate the utility of various population projection scenarios.
Interpret population change models to analyze future growth.
Demonstrate taxonomic classification by differentiating organisms.
Evaluate competition patterns within animal and plant species.</td></tr>
</table>

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Vocabulary: Carrying Capacity, Niche, Symbiosis, Commensalism, Parasitism
Resources: Gizmos (Rabbit Population), Edpuzzle (Population Ecology) **SEP and CCC Connections:** SEPs: Developing and Using Models (designing limiting factor models); Using Mathematics and Computational Thinking (interpreting population change models). CCCs: Patterns (exponential vs. logistic growth); Systems and System Models (natural regulation of population size).

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Priority Standard 7: Human Population Trends and Transitions	
Big Idea(s): ● Fresh water is a highly limited resource that requires complex management of surface and groundwater. ● Aquatic ecosystems—especially wetlands and estuaries—provide critical environmental functions and zonation	
Essential Question(s): ● How do point and non-point source pollutants differ in their impact on a watershed?. ● Why is groundwater pollution significantly more difficult to remediate than surface water pollution?	
Learning Outcomes	
Students will know:	**As evidenced by:**
7.1 Historical Human Growth Trends 7.2 Population Prediction Properties 7.3 Age Structure Trend Predictors 7.4 Demographic Transition Stages (Four Stages) 7.5 Developed vs. Developing Transition Comparisons 7.6 Rapid Growth Problems 7.7 Century Population Projections	● Analyze historical trends in human growth over the last 200 years. ● Identify properties used for predicting population sizes. ● Use Age Structure Diagrams to predict future resource needs. ● Identify the characteristics of the Four Stages of demographic transition. ● Compare stages of transition in developed vs. less developed countries. ● Analyze the Social and Environmental consequences of rapid urban growth. ● Review worldwide population projections for the next century. ● Interpret population graphs to evaluate a country's current demographic stage. ● Analyze strategies used by countries to reduce population growth. ● Calculate future resource needs based on age structure data. ● Evaluate the environmental consequences of rapid growth in urban areas. ● Compare growth problems in developed vs. less developed nations.

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Vocabulary: Demography, Fertility Rate, Replacement Level, Age Structure
Resources: Gapminder, Edpuzzle (Demographics), Population Connection **SEP and CCC Connections:** SEPs: Analyzing and Interpreting Data (interpreting population graphs); Using Mathematics and Computational Thinking (calculating future resource needs based on age structure). CCCs: Cause and Effect (social and economic problems caused by rapid growth); Patterns (demographic transition stages).

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Priority Standard 8: Aquatic Systems and Freshwater Resource Management	
Big Idea(s): ● Biodiversity is essential for ecosystem services and provides intrinsic and economic value to humans. ● Urban sprawl and the "urban crisis" alter the environment through effects like the heat island effect	
Essential Question(s): ● Why is protecting entire ecosystems more effective than focusing on individual species?. ● How can Geographic Information Systems (GIS) be used as a tool for sustainable land-use planning?	
Learning Outcomes	
Students will know:	**As evidenced by:**
8.1 Global Water Resource Distribution 8.2 Water Cycle Components 8.3 Watershed Relationships 8.4 Lake Zonation 8.5 Wetland and Estuary Functions 8.6 Eutrophication Causes and Effects 8.7 Pollution Source Categories 8.8 Federal Water Quality Laws	● Map the global distribution of Earth's water resources. ● Identify the components of the Water Cycle. ● Analyze the connection between Groundwater and Surface Water in a watershed. ● Differentiate between the Littoral and Benthic zones of a lake. ● Assess the environmental functions of wetlands and estuaries. ● Review the causes and effects of eutrophication. ● Identify examples of Point-source vs. Non-point-source pollution. ● Review major U.S. water quality laws. ● Design and conduct experiments to evaluate oil spill cleaning methods. ● Calculate personal daily water usage to identify conservation strategies. ● Evaluate water quality by analyzing plankton community data. ● Demonstrate water quality via Bio-Assessment and chemical analysis. ● Construct a pie chart of global water resource distribution. ● Interpret threats to coral reefs and ocean organisms based on pollution data.

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Vocabulary: Aquifer, Watershed, Eutrophication, Estuary, Benthic Zone
Resources: EPA Water Science, Gizmos (Water Cycle), USGS **SEP and CCC Connections:** SEPs: Planning and Carrying Out Investigations (evaluating oil spill cleaning methods); Analyzing and Interpreting Data (water quality bio-assessment and chemical analysis). CCCs: Systems and System Models (watershed relationships between groundwater and surface water); Cause and Effect (point and non-point source pollution impacts).

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Unit 4: Land Use, Energy, and Environmental Health

Unit 4 Anchoring Phenomena: The "Urban Crisis" (urban sprawl and heat islands) and the spread of emerging infectious diseases.

Priority Standard 9: Land Use, Biodiversity, and Conservation

Big Idea(s):

- The value of a fuel is determined by its energy content, cost, and environmental impact.
- Transitioning to a sustainable future requires balancing energy efficiency with renewable technologies

Essential Question(s):

- What are the environmental trade-offs between nuclear energy and fossil fuel consumption?.
- Which renewable energy forms (Solar, Wind, Hydro) are most beneficial for Connecticut's geography?

Learning Outcomes

Students will know:	As evidenced by:
9.1 Biodiversity Levels 9.2 Biodiversity Values 9.3 Hotspot and Endangered Species Threats 9.4 Endangered Species Act Provisions 9.5 Urban vs. Rural Land Use 9.6 Urban Sprawl and Crisis Factors 9.7 Open Space and Park Benefits 9.8 GIS Planning Utility 9.9 Heat Island Effects	• Distinguish between Genetic, Species, and Ecosystem biodiversity. • Assess the importance of biodiversity to ecosystems and humans. • Review threats to biodiversity hotspots and endangered species. • Map the main provisions of the Endangered Species Act. • Distinguish between urban and rural land use. • Evaluate the "urban crisis" and urban sprawl factors. • Identify the environmental benefits of open space and parks. • Demonstrate the utility of GIS for land-use planning. • Analyze the urban heat island effect. • Design a community wildlife preserve that evaluates species' needs. • Evaluate the environmental implications of urban sprawl. • Demonstrate how citizens can affect environmental policy at various levels. • Interpret global extinction threats through hotspot data.

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Vocabulary: Keystone Species, Biodiversity Hotspot, Urban Sprawl, GIS, Poaching
Resources: ArcGIS Online, WWF Species Directory, Gizmos (Rainforests) **SEP and CCC Connections:** SEPs: Constructing Explanations and Designing Solutions (designing a community wildlife preserve); Obtaining, Evaluating, and Communicating Information (demonstrating how citizens affect environmental policy). CCCs: Patterns (global extinction threats and hotspots); Scale, Proportion, and Quantity (urban sprawl and the value of single species)

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Priority Standard 10: Energy Systems and Environmental Toxicology

Big Idea(s):

- Human health is linked to the environment through toxicological exposure and waste management.
- Environmental factors, including human activities, determine the spread of emerging infectious diseases

Essential Question(s):

- How do scientists use the dose-response curve to determine safe levels of chemical exposure?
- How is risk assessed when pollutants come from both natural and human activities?

Learning Outcomes

Students will know:	As evidenced by:
10.1 Fossil Fuel Formation and Distribution 10.2 Nuclear Fission and Power Operations 10.3 Renewable Energy Forms 10.4 Efficiency vs. Conservation Concepts 10.5 Major Pollutant Health Effects 10.6 Toxicology and Epidemiology Principles 10.7 Dose-Response Curves and Risk Assessment 10.8 Infectious Disease Environmental Factors	● Review the formation and distribution of fossil fuels. ● Assess nuclear fission mechanism and power plant operations. ● Evaluate Solar, Wind, Geothermal, and Biomass options. ● Differentiate between energy efficiency and energy conservation. ● Map five major pollutants and their health effects. ● Review toxicology and epidemiology principles. ● Use a Dose-Response Curve to conduct a risk assessment. ● Analyze environmental factors in the spread of emerging infectious diseases. ● Calculate an individual carbon footprint based on fuel consumption. ● Evaluate oil extraction potential using three different methods. ● Design a state energy policy for Connecticut. ● Interpret a dose-response curve to assess toxin risk levels. ● Evaluate how household chemicals migrate into local watersheds. ● Analyze data from various countries to determine wealth-health correlations.

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Vocabulary: Fossil Fuel, Fission, Photovoltaic, Biomass, Toxicology, Dose-Response Curve
Resources: CT Energy Dashboard, Energy.gov, CDC Environmental Health, Gizmos (Nuclear) **SEP and CCC Connections:** SEPs: Using Mathematics and Computational Thinking (calculating individual carbon footprints); Analyzing and Interpreting Data (interpreting dose-response curves). CCCs: Cause and Effect (environmental factors determining the spread of disease; toxicological exposure and health effects).

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Appendix A: Vocabulary

- Abiotic: Non-living physical and chemical elements in the ecosystem, such as sunlight, temperature, and water.
- Adaptation: A change or the process of change by which an organism or species becomes better suited to its environment.
- Age Structure: The distribution of various age groups in a population, used to predict future growth trends.
- Altitude: The height of an object or point in relation to sea level or ground level.
- Aquifer: A body of permeable rock that can contain or transmit groundwater.
- Benthic Zone: The lowest level of a body of water, including the sediment surface and some sub-surface layers.
- Biodiversity Hotspot: A biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction.
- Biomass: Organic matter used as a fuel, especially in a power station for the generation of electricity.
- Biome: A large naturally occurring community of flora and fauna occupying a major habitat.
- Biotic: Relating to or resulting from living things, especially in their ecological relations.
- Carrying Capacity: The maximum population size of a biological species that can be sustained in a specific environment.
- Commensalism: An association between two organisms in which one benefits and the other derives neither benefit nor harm.
- Demography: The study of statistics such as births, deaths, income, or the incidence of disease, which illustrate the changing structure of human populations.
- Dose-Response Curve: A gradient that shows the relationship between the amount of a substance (dose) and its effect (response) on an organism.
- Ecological Footprint: A measure of how much area of biologically productive land and water an individual or population requires to produce all the resources it consumes and to absorb its waste.
- EIS (Environmental Impact Statement): A document required by federal law for certain actions "significantly affecting the quality of the human environment".
- Estuary: The tidal mouth of a large river, where the tide meets the stream.
- Eutrophication: Excessive richness of nutrients in a lake or other body of water, frequently due to runoff from the land, which causes a dense growth of plant life and death of animal life from lack of oxygen.
- Feedback Loop: A biological occurrence wherein the output of a system amplifies (positive) or inhibits (negative) the system.
- Fertility Rate: The average number of children born to women in a specific population.
- Fission: A nuclear reaction in which a heavy nucleus splits spontaneously or on impact with another particle, with the release of energy.
- Fossil Fuel: A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.
- GIS (Geographic Information System): A system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.
- Greenhouse Effect: The trapping of the sun's warmth in a planet's lower atmosphere due to the greater transparency of the atmosphere to visible radiation from the sun than to infrared radiation emitted from the planet's surface.
- Keystone Species: A species on which other species in an ecosystem largely depend, such that if it were removed the ecosystem would change drastically.

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- Latitude: The angular distance of a place north or south of the earth's equator.
- Natural Selection: The process whereby organisms better adapted to their environment tend to survive and produce more offspring.
- Niche: The role and position a species has in its environment.
- Non-renewable (Resource): A natural resource that cannot be readily replaced by natural means at a quick enough pace to keep up with consumption.
- Parasitism: A relationship between two species of plants or animals in which one benefits at the expense of the other.
- Pesticide Resistance: The decreased susceptibility of a pest population to a pesticide that was previously effective at controlling the pest.
- Photovoltaic: Relating to the production of electric current at the junction of two substances exposed to light.
- Poaching: The illegal practice of trespassing on another's ground to hunt or fish, or the illegal killing/capture of protected species.
- Renewable (Resource): A resource which can be used repeatedly and replaced naturally.
- Replacement Level: The level of fertility at which a population exactly replaces itself from one generation to the next.
- Stratification: The arrangement or classification of something into different groups (in ecology, the vertical layering of a habitat).
- Stratosphere: The layer of the earth's atmosphere above the troposphere, which contains the ozone layer.
- Sustainability: The ability to be maintained at a certain rate or level; in environmental science, meeting the needs of the present without compromising the ability of future generations to meet theirs.
- Symbiosis: Interaction between two different organisms living in close physical association.
- Toxicology: The branch of science concerned with the nature, effects, and detection of poisons.
- Tragedy of the Commons: An economic problem in which every individual has an incentive to consume a resource, but at the expense of every other individual—with no way to exclude anyone from consuming.
- Urban Sprawl: The uncontrolled expansion of urban areas.
- Watershed: An area or ridge of land that separates waters flowing to different rivers, basins, or seas.
- Weathering: The process of wearing or being worn by long exposure to the atmosphere.