Unit 7: Climate Change and Environmental Engineering

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 4**
Length: **2-3 weeks**
Status: **Published**

Summary

Introduction:

Students will develop strategies to mitigate climate change. Students will explore why New Jersey has a zero-runoff requirement. Students will study the impacts of excessive water runoff and its causes. They will develop plans for a rain garden in CAD for a proposed house. Student plans will be based on information garnered from a design manual from Rutgers University.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions:

How do environmental engineers use scientific and engineering principles to solve complex problems and improve the well-being of both human and ecological systems?

How have historical factors, such as public health crises, industrialization, and evolving legislation, shaped the focus and priorities of environmental engineering over time?

How does the global challenge of climate change compel environmental engineers to not only mitigate its effects but also design resilient infrastructure for a changing world?

Enduring Understandings:

Environmental engineering falls into one of three categories engineering discipline by itself, a specialty within chemical engineering, or a specialty within civil engineering.

Environmental engineering problems are large-scale and generally relate to air and water.

Environmental engineering solutions provide mitigation of problems caused by global warming.

Objectives

Students Will Know:

environmental engineers with a chemical engineering concentration tend to focus on environmental problems with air.

environmental engineers with a civil engineering concentration tend to focus on problems relating to water.

environmental engineers are involved with the remediation of problems like air and water pollution.

impact assessments are performed when projects may affect the environment.

vocabulary and terms: zero-runoff, contour line, drainage, rain garden, slope, grade, elevation, EPA (Environmental Protection Agency), pollution, hydrology, sanitation engineer, environmental impact study, conservation, acid rain, ozone, green house effect, global warming, climate change, waste management, and vocabulary that is project specific.

Students Will Be Skilled At:

Designing a rain garden.

Using a technical manual to follow a procedure.

Making a technical drawing.

Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Formative assessments will be conducted throughout the process using class discussion, student writing, and practice quizzes.

Formative assessments will be conducted to determine knowledge of computers, robotics, and mechanical engineering.

Lectures and lessons will be provided to develop an understanding of environmental engineering.

Invite and connect with local experts on the topic to provide lectures.

Plan field trips to the Rahway River for students to make on-site observations.

Review climate change predictions.

Formative assessments will be conducted throughout the design process.

Suggested problem or project-based learning activity: the design of a rain garden for a house in New Jersey to meet zero-runoff statutory requirements. Students will use primary sources for design requirements, make their design in CAD. Students will provide computations.

Summative assessments will be conducted throughout to evaluate skills acquisition.

Design logs will be maintained to document the application of the design loop.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Complete unit test and/or quiz.

Complete writing prompt.

Assessment

Formative Assessment:

participation in discussions on environmental engineering

teacher feedback on rain garden designs

exit tickets

proper use of vocabulary as it relates to environmental engineering

Summative evaluation:

perform a problem-based learning activity: the design of a rain garden for a house in New Jersey. Solutions to meet the requirements of a rubric.

complete writing prompts: "As the Rahway River travels through many towns, buildings has had a significant impact on its vitality, this includes:…strategies for remediation include…."

Answer the essential questions.

Alternate Assessment:

Presentation on original rain garden design

Benchmark evaluation:

Mid Term/Final exam

Materials

AutoCAD and CAD LAB

Teacher e-board. The e-board contains descriptions and research information about the first surgeries in the series.

Students will use WEB 2.0 applications like Google Docs to collaborate on projects.

Email and e-board

Web sites

SmartBoard use for teacher presentation and interactive lessons

SmartBoard use for student presentations.

Summary

ELA.L	Language
ELA.L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
TECH.K-12.1.3	Knowledge Constructor
	Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
TECH.K-12.1.3.a	plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
LA.RST.9-10	Reading Science and Technical Subjects
	Key Ideas and Details
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, 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.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
SCI.HS-ESS2	Earth's Systems
SCI.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
	Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.
SCI.HS.ESS2.D	Weather and Climate

	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 reradiation into space.
SCI.HS.ESS2.D	Weather and Climate
	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 reradiation into space.
	Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
SCI.HS-ESS3	Earth and Human Activity
SCI.HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
	Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).
SCI.HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
	Using Mathematics and Computational Thinking
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
	Asking Questions and Defining Problems
SCI.HS.ETS1.A	Delimiting Engineering Problems
	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
	Constructing Explanations and Designing Solutions
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
	Using Mathematics and Computational Thinking
SCI.HS.ETS1.B	Developing Possible Solutions
	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
CS.9-12.8.2.12.ED.1	Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.ED.4	Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
CS.9-12.8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
CS.9-12.8.2.12.ED.6	Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).
CS.9-12.ED	Engineering Design
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.DC	Digital Citizenship
TECH.9.4.12.TL	Technology Literacy
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	Securing an income involve an understanding of the costs and time in preparing for a career field, interview and negotiation skills, job searches, resume development, prior experience, and vesting and retirement plans.
	Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.
	There are strategies to improve one’s professional value and marketability.

Integrated Accommodation and Modifications...

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education and those with 504s