Unit 07: Sustainability and the Environment

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

Brief Summary of Unit

Introduction: Students will explore sustainability, mechanical building systems, and the environmental impact of buildings. Mechanical engineering topics will be explored, including technical data about the units and sustainable design. Students will use the Building Energy Codes Program software to develop assemblies meeting energy code criteria. Students will explore how climate change affects building design and site selection. Students will develop an appreciation that buildings are designed to respond to their environment.

Revision Date: July 2023

Essential Questions/Enduring Understandings

Essential Questions

What is meant by sustainable design?

What factors contribute to sustainable design?

What strategies are used to make building sustainable?

Enduring Understandings

Sustainable design concerns how the built environment (ex. buildings, parking lots, roads) functions with the current environment and its changes.

Ancient and modern strategies are employed to make building sustainable.

Objectives

Students Will Know:

Key terms: runoff, refrigeration, passive & active solar, insulation, geothermal, Trombe wall. climate change/global warming,

Sustainability concerns the life cycle of a building.

The vocabulary of mechanical and environmental systems design.

The potential environmental impact of runoff.

How to calculate runoff on a site.

Strategies to reduce runoff from a site.

Traditional types of systems are used to heat and cool homes.

Systems to heat and cool homes with less environmental impact, including solar and geothermal.

Factors that affect building energy usage include insulation, shading, and glazing.

Graphic techniques that communicate an understanding of how the systems work.

Students Will Be Skilled At:

Implementing strategies to make buildings more sustainable.

Implementing strategies to make building have less impact on the environment.

Assessment

Formative

Meaningfully address the essential and guiding questions of this unit of study.

Meaningfully participate in guided question and answer sessions, and group and individual discussions, show an understanding of the purpose of the unit lesson(s), and their key terms and concepts.

Complete writing prompts. Examples:

Runoff from housing developments may not affect the local community, but …

New Jersey's zero runoff law is good because…

Reducing the amount of energy consumed in a house benefits society and the owner...

Exit ticket

Summative

Design a solution to a problem involving runoff and graphically represent the solution. Presentation to be evaluated with the use of teacher and student-designed rubrics.

Design a house that employs energy-saving strategies. Graphically communicate the solution. Presentation to be evaluated with the use of teacher and student-designed rubrics.

Presentations will be included in an electronic portfolio.

Complete written tests and quizzes on unit topics and vocabulary.

Benchmark

Midterm Exam/Final Exam

Alternative Assessment

Perform research about the impact that buildings have on the environment and the socio/political impact energy consumption has. Presentation to be evaluated with the use of teacher and student-designed rubrics.

Learning Plan

Pre-assessment to determine the direction of work.

Preview the essential questions and connect to learning throughout the unit. Leading questions: Why do we choose different materials for buildings? Why do houses Victorian houses in Cranford have porches? What elements in a house keep it cool in summer and warm in winter, are there ways to maintain comfort with less energy? What are the energy needs of a building? What is runoff? Where does water runoff go? What is the impact on the environment? What is meant by "zero runoff" How much energy, on a national basis is used for heating and cooling homes? Does it matter? What technologies are used in heating and cooling? What is active and passive solar design? What other strategies can be used to control the climate in a building? (Shading devices, geothermal, insulation, trees…). Why do we need to make drawings of these systems? Who is the audience for these drawings? What is the vocabulary for building systems? What do runoff and passive solar heating systems have in common?

Lecture and discussion about the guiding questions.

Formative assessments will be conducted throughout the research problem.

Research problem(s): What is the energy and environmental impact of building in the United States?

Summative assessment will be conducted by the student and teacher using a rubric specific to the research problem which may include student-driven goals.

Formative assessment will be conducted thorough out the process with class discussion, student writing, practice quiz, and review of student work.

Formative assessments will be conducted throughout the design process.

Possible proposed design problems: develop a plan to manage runoff from a neighborhood or a mall. Develop plans for an energy-efficient house.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem which may include student-driven goals

Formative assessments will be conducted throughout the design process.

Design problem: design a house that employs strategies to heat and cool efficiently.

Design problem: design a house that employs passive solar technologies.

Summative assessment will be conducted by the student and teacher using a rubric specific to the research problem which may include student-driven goals

Lecture and discussion about strategies to heat, cool, and reduce fossil fuel consumption.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem which may include student-driven goals

Complete quizzes and unit tests.

Suggested Technology:

Energy Calculator: RESCHECK. US Department of Energy. (Software)

Web sites.

CAD and other software programs.

Smart Board use for presentations and interactive lessons.

Materials

Computer lab with AutoCAD software, one computer per student

White board with projector or Smartboard

CADD Lab including 3d printers, drill press, scroll saw and power drill, soldering iron, xacto knives, and hand tools.

Standards

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
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.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
LA.RST.9-10.7	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.
LA.RST.9-10.10	By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
SCI.HS.ETS1.A	Delimiting Engineering Problems
SCI.HS.ETS1.B	Developing Possible Solutions
SCI.HS.ETS1.B	Developing Possible Solutions
SCI.HS.ETS1.C	Optimizing the Design Solution
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.
SCI.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
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.
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.
SCI.HS-ETS1	Engineering Design
TECH.K-12.1.1	Empowered Learner
TECH.K-12.1.1.a	articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
TECH.K-12.1.1.c	use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
TECH.K-12.1.2	Digital Citizen
TECH.K-12.1.2.c	demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.
TECH.K-12.1.2.d	manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.
TECH.K-12.1.3	Knowledge Constructor
TECH.K-12.1.3.a	plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
TECH.K-12.1.3.c	curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
TECH.K-12.1.3.d	build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
TECH.K-12.1.4	Innovative Designer
TECH.K-12.1.4.a	know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
TECH.K-12.1.4.b	select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
TECH.K-12.1.4.c	develop, test and refine prototypes as part of a cyclical design process.
TECH.K-12.1.6	Creative Communicator
TECH.K-12.1.6.a	choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
TECH.K-12.1.6.b	create original works or responsibly repurpose or remix digital resources into new creations.
TECH.K-12.1.6.c	communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
TECH.K-12.1.6.d	publish or present content that customizes the message and medium for their intended audiences.
	Using Mathematics and Computational Thinking
	Constructing Explanations and Designing Solutions
	Key Ideas and Details
	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.
	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.

Asking Questions and Defining Problems

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