Unit 11: Sustainable Design

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **5 Weeks**
Status: **Published**

Brief Summary of Unit

Introduction

Students will develop knowledge and understanding related to sustainable design and its role in addressing environmental challenges within the built environment. Topics will include solar energy strategies, energy codes, stormwater management and zero-runoff design, water-heating technologies, green building initiatives, renewable energy systems, and strategies for reducing energy consumption and environmental impact. Students will examine how sustainable design principles can be integrated into architectural solutions to improve building performance, reduce carbon emissions, and promote environmental stewardship.

Students will apply research, analysis, and design-thinking skills to evaluate sustainable technologies and design strategies. In addition, students will construct physical and/or digital models that communicate their design solutions and demonstrate how those solutions can reduce carbon footprints, improve resource efficiency, and contribute to climate change mitigation. This unit will run concurrently with other units throughout the school year.

Revision Date: July 2026

Essential Questions/Enduring Understandings

Essential Questions:

What is sustainable design, and how can it be incorporated into the built environment?

Why is sustainable design an important consideration in modern architecture and construction?

What design practices, technologies, and strategies promote sustainable development?

Enduring Understandings:

Sustainable design seeks to reduce the environmental impact of buildings while promoting the efficient use of energy, water, materials, and other natural resources.

Sustainable design addresses both the construction of a building and its long-term environmental, economic, and social impacts throughout its life cycle.

Design decisions that negatively impact the environment can contribute to climate change, increased energy consumption, flooding, habitat loss, and other long-term environmental challenges.

Practices that reduce the environmental impact of buildings include green building technologies, energy-efficient systems, renewable energy strategies, sustainable material selection, and stormwater management

techniques that reduce runoff and protect natural resources.

Students Will Know/Students Will Be Skilled At

Students will know:

- Historical building practices can provide valuable strategies for reducing the need for mechanical heating and cooling. Examples may include Hopi housing in Arizona and innovations such as the Trombe wall.
- Active solar systems require added equipment or technology, such as photovoltaic panels or solar hot water panels installed on a building.
- Passive solar design is integrated into the building itself, such as masonry floors designed to retain heat, overhangs designed to shade windows, or window placement that maximizes solar gain.
- Shading devices can be designed to control sunlight differently during various seasons.
- The components and functions of an active solar system.
- The components and functions of a passive solar system.
- Design decisions can reduce the environmental impact of buildings, lower carbon footprints, and help address climate change.
- Sustainable design strategies can influence the appearance, function, and overall aesthetics of a building.

Students will be skilled at:

- Designing an effective shading device for a building.
- Proposing an appropriate active solar strategy or device for a building.
- Critically distinguishing between functional requirements and aesthetic choices within a design.
- Analyzing how technology influences building form, performance, and design decisions.
- Solving design problems efficiently through the use of the design loop.
- Developing and presenting project work through a professional digital portfolio.

Learning Plan

- Preview the essential questions and establish connections to the concepts, skills, and learning objectives that will be explored throughout the unit.

- Examine guiding questions, including:

    - What is an awning, and how does it function as a shading device?

    - Under what conditions is an awning most effective, and when is it least effective?

    - How can a shading device be designed to address morning, afternoon, or seasonal sun exposure?

    - What resources and tools can be used to determine the position of the sun at different times of

the day and year?

  - During which seasons is solar gain most beneficial within a building?
  - How can building orientation influence energy efficiency and occupant comfort?
  - What strategies can be used to store and retain heat within a building?
  - How can passive and active solar design strategies reduce energy consumption?
  - How do sustainable design decisions affect both building performance and architectural aesthetics?

- Research and prepare an analysis of sustainable design topics, including Hopi housing, Trombe wall design, photovoltaic systems, solar hot water generation, insulation strategies, passive solar design, and other energy-efficient building technologies.
- Evaluate historical and contemporary examples of sustainable design and assess how these approaches can reduce environmental impacts and improve building performance.
- Participate in lectures, discussions, and demonstrations focused on sustainable design principles, renewable energy systems, and environmentally responsible building practices.
- Observe demonstrations of architectural presentation techniques, which may include airbrush rendering, pen-and-ink illustration, digital visualization, and other professional presentation methods.
- Apply sustainable design strategies and technologies to projects developed in other units throughout the course.
- Incorporate passive and active solar design concepts into architectural solutions and evaluate their effectiveness in reducing energy consumption and environmental impact.
- Formative assessments will be conducted throughout the design process to monitor student understanding, provide feedback, and support the refinement of design solutions.
- Summative assessment of sustainable design applications will be conducted collaboratively by the student and teacher using a rubric specific to the project and design challenge.
- Complete a unit test or quiz assessing understanding of sustainable design principles, renewable energy systems, environmental impacts, and related course content.
- Complete a written response or writing prompt. Possible prompt: "The effect of the sustainable design strategies on the aesthetics of the building was..." or "How can sustainable design strategies improve building performance while maintaining architectural quality?"

Assessment

Formative Assessments:

Assessment of prior knowledge will be conducted at the beginning of each applicable unit to identify student

understanding and inform instruction.

Summative Assessment:

Answer the essential questions.

Demonstrate, through technical drawings and design solutions, the integration and application of sustainable design concepts and strategies.

Demonstrate the ability to use software and technical drawing conventions to communicate design solutions effectively and professionally.

Design and create presentation drawings that explain how a sustainable building strategy or technology functions and contributes to environmental performance.

The presentation will be evaluated using teacher- and student-designed rubrics.

Maintain a design log documenting how the design evolved, including sources of information, research, feedback, revisions, and critiques.

The completed presentation will be included in an electronic portfolio.

Respond to one or more writing prompts. Possible prompts may include: "What sustainability considerations should be evaluated when selecting building materials?" and "What design strategies can be used to reduce energy consumption in buildings while maintaining occupant comfort and performance?"

Alternative Assessment:

Presentation on sustainable building practices and how they can be used to reduce carbon footprints, improve environmental performance, and help address climate change.

Benchmark Assessment:

Final Exam

Materials

The CADD LAB-computers equipped with up-to-date AutoCAD and/or other design and drafting software, presentation software, productivity software, a scanner and printers/plotters.

Traditional drafting equipment and supplies-vellum, colored and graphite pencils, pen and ink, drawing boards, tape, scissors, t-squares, triangles etc.

Chip-board, X-acto knives and other model making supplies.

A computer with INTERNET based presentation software (i.e. Prezi and Google Slides) and Microsoft Powerpoint.

3-D printer and supplies

Safety glasses

INTERNET resources and tutorials on how to use CAD software.

Teacher e-board.

SmartBoard use for teacher presentation and interactive lessons

SmartBoard use for student presentations.

Model making materials, dependant on projects that used.

Standards

9.4.12.CI	Creativity and Innovation
9.2.12.CAP	Career Awareness and Planning
TECH.K-12.1.1	Empowered Learner
L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
	There are strategies to improve one’s professional value and marketability.
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.
	Innovative ideas or innovation can lead to career opportunities.
9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
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.
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
9.4.12.CT	Critical Thinking and Problem-solving
TECH.K-12.1.2	Digital Citizen
L.KL.9–10.2	Apply knowledge of language to make effective choices for meaning, or style, and to comprehend more fully when reading, writing, speaking or listening.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
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).

9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
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.
L.VL.9–10.3	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, including technical meanings, choosing flexibly from a range of strategies.
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.
L.VI.9–10.4	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings, including connotative meanings.
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.
9.4.12.GCA	Global and Cultural Awareness
9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
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.
9.4.12.TL	Technology Literacy
	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
	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.
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.
	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
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.
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.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
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).
ETW	Effects of Technology on the Natural World
	Development and modification of any technological system needs to take into account how the operation of the system will affect natural resources and ecosystems. Impacts of technological systems on the environment need to be monitored and must inform decision-making. Many technologies have been designed to have a positive impact on the environment and to monitor environmental change over time.
HS-ETS1	Engineering Design
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
	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
ETS1.A	Delimiting Engineering Problems
	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
	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.
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.
	Constructing Explanations and Designing Solutions
ETS1.C	Optimizing the Design Solution

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