Unit 9: Engineering Design

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

Summary

Introduction:

Students pursue an area of personal interest in an engineering field. Options include the timely pursuit of a competition, expand upon a previous topic, extend a current topic, or investigate a new engineering topic. Students will explore the engineering design laboratory models of the 19, 20 and 21st century.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions:

What systematic process do engineers use to identify a problem, develop a solution, and evaluate its effectiveness?

How do engineers apply scientific principles and mathematical reasoning to design, build, and maintain structures, systems, and products that benefit society?

In what ways does the continuous evolution of technology influence engineering practices and drive the creation of new solutions to complex problems?

Enduring Understandings:

Engineers of different disciplines are involved with solving problems.

Engineers use methodology to solve problems.

That technology change relates to the design loop-the last step, is the first step.

Objectives

Students Will Know:

engineering is the application of science to benefit mankind.

how to apply the design loop to solve a problem.

prototypes, written and oral presentations help to communicate solutions of problems effectively.

safety concerns regarding tools and machinery.

technology is always changing.

the design loop ends the way it starts-with an observed problem.

vocabulary related to each student's topic.

Students Will be Skilled At:

Meeting the expectations of an engineering design brief or other written document.

utilizing vocabulary as related to their topic.

determine safety concerns and precautions needed.

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 throughout the design process. Problem-based learning: Students will develop a solution to an engineering problem they choose. Working in groups or alone, they will apply the design loop to develop a solution. Students may explore a previous unit's work—make another computer game, or another engineering discipline. Examples: mechanical engineering-a carnival-type ride, robotics machine for making pizza, electrical electric chafing dish, civil engineering-a bridge. The project may coincide with a competition.

Current Events: identify trends in power production and explain how they relate to engineering and society.

Historical models-possible field trip to an engineering laboratory. (possibly Thomas Edison Laboratory in West Orange).

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 class discussion

student writing and practice quizzes

exit tickets

teacher feedback on problem based learning

Summative assessment:

perform a problem based learning activity focusing on a problem a student identifies. The project will include a prototype, written report, and an oral presentation that demonstrates the use of digital media. Students will provide handouts of vocabulary. The project will be graded using a rubric.

Complete writing prompts: Explain how your project is better than those of the past and how it relates to the nature of technology. Explain how the development of your project relates to the design loop.

answer the essential questions.

Alternate Assessment:

shadow and report on a mechanical engineer

Benchmark assessment:

Mid Term/Final exam

Materials

CAD and other software programs

SmartBoard use for teacher presentation and interactive lessons

Teacher e-board.

Parts as needed for individual projects

Phones to record still and video

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

Robotics computer lab with NXT software, presentation software.

Robotics computer lab with Boe-Bot and LEGO NXT software

Robotics computer lab with Arduino software

Email and e-board

SmartBoard use for student presentations.

Standards

ELA.L	Language
ELA.L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
LA.RST.11-12	Reading Science and Technical Subjects
	Key Ideas and Details
LA.RST.11-12.1	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.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
TECH.K-12.1.4	Innovative Designer
LA.RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
	Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
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.
SCI.HS-ETS1	Engineering Design
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.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.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.ED	Engineering Design
WRK.9.2.12.CAP	Career Awareness and Planning
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.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.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
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.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
TECH.9.4.12.DC	Digital Citizenship
	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.
	Innovative ideas or innovation can lead to career opportunities.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
	With a growth mindset, failure is an important part of success.
	There are strategies to improve one’s professional value and marketability.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.

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