Unit 1: The Engineering Design Process

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **3 Weeks**
Status: **Published**

Summary

Students will be introduced to the engineering design loop. They will use the design loop as a problem-solving framework throughout the year. Initially, an illustrative problem will be practiced and solved by the class. Students will appreciate the value of using the framework to solve problems more efficiently. Students will maintain design logs to formally describe their problem solving path. The unit will run concurrently with other units throughout the semester.

Revision Date: July 2024

Essential Questions/Enduring Understandings

Essential Questions:

How does problem solving relate to the design loop and how do engineers use it to solve problems?

How is a design log used in corporate practice?

Why is the formal application of the design loop essential?

Enduring Understandings:

Engineers use the design loop as a method to efficiently/effectively solve problems.

Using the design loop becomes a natural process with practice.

Solving a problem with the design loop involves re-evaluating a solution as you problem-solve.

Objectives

Students will know:

that the scientific method is used to test a hypothesis.

that the design loop is a method for solving problems that have more than one solution.

the definition of engineering and how it relates to the design loop.

that the design loop is an iterative process how to apply the design loop to an engineering problem.

that hard copy design logs are maintained in the industry for patent protection.

Students will be skilled at:

applying the design loop to a problem

using a design log to document their work

using the design loop to develop multiple solutions to a problem

using a prototype to develop a design

Learning Plan

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

Lecture and discussion about guiding questions.

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

Students will use the design loop as a guide to development of a solution to a problem, typically lasting one period. They will use a design log to show the development of the project.

The design loop will be used as the structure for problem solving throughout the course. These problems will be elaborated in other units, but include a bridge design and sensor design, program robots to perform tasks and development of subassemblies like battery packs, and gear systems.

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

Teacher will demonstrate and involve students in presentation techniques using SMART technology and PowerPoint.

Complete unit test or quiz.

Complete writing prompts.

Websites-concerning steps of the design loop.

Assessment

Formative assessment:

answer the essential and guiding questions of this unit of study.

actively participate in guided question and answer sessions, group and individual discussions, and demonstrate an understanding of the purpose of the unit lessons and the key terms and concepts.

demonstrate in design logs the ability to document the design process.

use unit vocabulary in a design log and in class discussions and interactions.

Summative assessment:

Project: student design that is created as a product of an iterative process.

Demonstrate the ability to utilize the design loop as a problem-solving tool for a test grade.

Benchmark Assessment:

Final Exam

Alternate Assessment:

Project/Presentation on Design Loop

Materials

Notebooks

SmartBoard Presentations

Email and e-board

Web sites

CAD and other software programs

Smartboard use for presentation and interactive lessons

Virtual Field Trips

Paper clips, tape, paper

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.
TECH.K-12.1.4	Innovative Designer
	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.
MATH.9-12.A.REI	Reasoning with Equations and Inequalities
MATH.9-12.A.REI.A	Understand solving equations as a process of reasoning and explain the reasoning
TECH.K-12.1.5	Computational Thinker
	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
TECH.K-12.1.5.a	formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
TECH.K-12.1.5.b	collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
TECH.K-12.1.5.c	break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
TECH.K-12.1.5.d	understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.
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.
SCI.HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
	Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.
SCI.HS.ESS3.A	Natural Resources
	All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.
SCI.HS.ETS1.B	Developing Possible Solutions
	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

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
CS.9-12.IC	Impacts of Computing
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
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).
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	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.
	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.
	The design and use of computing technologies and artifacts can positively or negatively

affect equitable access to information and opportunities.

Innovative ideas or innovation can lead to career opportunities.

Career planning requires purposeful planning based on research, self-knowledge, and informed choices.

Integrated Accommodation and Modifications, Special Education students...

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