Unit 9: Engineering Design

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 4**
Length: **15 days**
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.

Revision Date: July 2020

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.
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.
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
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.

CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.
SCI.HS	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.
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-ETS1-4	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-ETS1-3	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.
WRK.9.2.12.CAP	Career Awareness and Planning
TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A	Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.C.5	Create scaled engineering drawings of products both manually and digitally with materials and measurements labeled.
TECH.8.2.12.C.7	Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.
TECH.8.2.12.C.CS1	The attributes of design.
TECH.8.2.12.C.CS2	The application of engineering design.
TECH.8.2.12.D	Abilities for a Technological World: The designed world is the product of a design process

	that provides the means to convert resources into products and systems.
TECH.8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.
TECH.8.2.12.D.CS1	Apply the design process.
TECH.8.2.12.D.CS2	Use and maintain technological products and systems.
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 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.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	Innovative ideas or innovation can lead to career opportunities.
	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.
	With a growth mindset, failure is an important part of success.

Essential Questions/Enduring Understandings

Essential Questions:

How do engineers solve problems?

What do engineers do?

How does technology change over time?

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 individual student's topic.

Students Will be Skilled At:

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

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 other engineering discipline. Examples: mechanical engineering-a carnival type ride, robotics-a

machine for making pizza, electrical-an 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.

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:

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 software

Robotics computer lab with Arduino software

Email and e-board

SmartBoard use for student presentations.

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