Unit 18: Engineering Design

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

Brief Summary of Unit

Students will develop individual projects that apply engineering concepts.

Standards

MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
LA.RI.11-12.2	Determine two or more central ideas of a text, and analyze their development and how they interact to provide a complex analysis; provide an objective summary of the text.
LA.RI.11-12.3	Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.
LA.RI.11-12.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
LA.RI.11-12.5	Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.
LA.RI.11-12.6	Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness or beauty of the text.
LA.RI.11-12.10b	By the end of grade 12, read and comprehend literary nonfiction at grade level text-complexity or above.
SCI.HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
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.
TECH.8.1.8.D.3	Demonstrate an understanding of fair use and Creative Commons to intellectual property.
TECH.8.1.8.D.5	Understand appropriate uses for social media and the negative consequences of misuse.
TECH.8.1.12.D.1	Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
TECH.8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
TECH.8.2.12.A.1	Propose an innovation to meet future demands supported by an analysis of the potential full costs, benefits, trade-offs and risks, related to the use of the innovation.

TECH.8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
TECH.8.2.12.B.1	Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.
TECH.8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
TECH.8.2.12.B.5	Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review.
TECH.8.2.12.C.4	Explain and identify interdependent systems and their functions.
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.6	Research an existing product, reverse engineer and redesign it to improve form and function.
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.3	Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.
TECH.8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.
TECH.8.2.12.E.2	Analyze the relationships between internal and external computer components.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).

Transfer

Essential Questions

- • How do engineers solve problems?
- • What is engineering?
- • What is the nature of technology?

Essential Understandings

- • design logs are meant to be understood by those within the discipline and are technical.
- • engineers solve problems by applying science.

- technology is always evolving as a response to new problems.
- the design brief provides criteria for a successful innovation.
- the unit vocabulary is discipline specific and technical.

Students Will Know

- how to make a design brief.
- how to solve a technological problem.
- key terms: design loop, design brief, prototyping, iterative, invention, innovation.
- that problem solving starts with identification of a problem.
- that the design log is used to track your design evolution.
- the steps of the design loop.

Students Will Be Skilled At

Evidence/Performance Tasks

- demonstrate the ability to utilize the design loop as a problem solving tool.
- demonstrate understanding on written quizzes and tests about subject materials.
- meaningfully address the essential and guiding questions of this unit of study.
- meaningfully participate in guided question and answer sessions, group and individual discussions, show an understanding of the purpose of the unit lesson(s), and their key terms and concepts.
- problem based learning: each student will identify a problem and design and prototype a solution. Problems should relate to and expand upon topics in previous units. The project and presentation will be evaluated using teacher and student designed rubrics.
- use unit vocabulary in written and oral communication.

Learning Plan

- Complete quizzes on other students' research and vocabulary.
- Complete summative assessment by the student and teacher using a rubric specific to the problem which may include student driven goals.
- Complete unit test.
- Conduct formative assessment throughout the process with class discussion, student writing, practice quiz and review of student work.
- Conduct formative assessments throughout the design problem.
- Conduct group critique and presentation.
- Design problem: Student or teacher will establish an observed problem, and choose an

independent project to solve the problem. Students will present the device and a digital presentation.

- Pre-assessment to determine the direction of work
- Preview the essential questions and connect to learning throughout the unit.
- Provide guidance and rubrics for the development of a digital portfolio.
- Provide lecture and opportunities for discussion about the guiding questions.

Materials

- CAD and other software programs
- DVDs
- Email and e-board
- Robotics lab equipped with MATLAB, PSpice, power supplies, logic testers, various electrical components, drill press and tools.
- SmartBoard use for presentation and interactive lessons
- Virtual Field Trips
- Web sites

Suggested Strategies for Modifications

- additional time on task
- alternative outcome options
- assessment based on individual development in the area of study
- audio tape of instruction
- cooperative learning groups
- handouts of notes, procedures, processes, diagrams, etc.
- images and visual aids
- one-to-one instruction and assistance
- preferential seating
- reading material modified to student level
- study partners
- testing materials appropriate to student level