Unit 03: The Design Loop & Documentation

Content Area:	**Applied Technology**
Course(s):	
Time Period:	**Marking Period 1**
Length:	**2 Weeks**
Status:	**Published**

Summary

Introduction: Students will use the engineering design loop to solve problems throughout the course. The steps of the design loop are explored. Students will document their work in a design log. The design log will emphasize clarity, attribution of sources, and consistency.

Revision Date: July 2022

Standards

LA.RST.9-10	Reading Science and Technical Subjects
	Key Ideas and Details
LA.RST.9-10.1	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.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
	Integration of Knowledge and Ideas
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.WHST.9-10	Writing History, Science and Technical Subjects
LA.WHST.9-10.1.D	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
	Production and Distribution of Writing
LA.WHST.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.WHST.9-10.6	Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
CS.9-12.8.1.12.CS.4	Develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors.

CS.9-12.8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.
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.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.ETW.2	Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
CS.9-12.8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
CS.9-12.EC	Ethics & Culture
CS.9-12.ED	Engineering Design
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.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.DC.1	Explain the beneficial and harmful effects that intellectual property laws can have on the creation and sharing of content (e.g., 6.1.12.CivicsPR.16.a).
TECH.9.4.12.DC.3	Evaluate the social and economic implications of privacy in the context of safety, law, or ethics (e.g., 6.3.12.HistoryCA.1).
TECH.9.4.12.DC.4	Explain the privacy concerns related to the collection of data (e.g., cookies) and generation of data through automated processes that may not be evident to users (e.g., 8.1.12.NI.3).
TECH.9.4.12.TL	Technology Literacy
TECH.9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
	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.
	Laws govern the use of intellectual property and there are legal consequences to utilizing or sharing another's original works without permission or appropriate credit.
	Engineers use science, mathematics, and other disciplines to improve technology. Increased collaboration among engineers, scientists, and mathematicians can improve their work and designs. Technology, product, or system redesign can be more difficult than the original design.
	Laws govern many aspects of computing, such as privacy, data, property, information, and identity. These laws can have beneficial and harmful effects, such as expediting or delaying advancements in computing and protecting or infringing upon people's rights.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.

Essential Questions/Enduring Understandings

Essential Questions:

How do engineers solve problems?

How do engineers document and protect their work?

What are copyright and patent?

Essential Understandings:

Engineers develop and apply scientific principles to solve problems

The engineering design loop is used to solve problems where multiple solutions exist.

The engineering design loop is an iterative process composed of a series of steps.

Engineers use design logs to methodically document their work and cite attribution of ideas.

Properly made design logs are used in courts to determine ownership of ideas.

Copyrights and patents are granted for original work and inventions by governments. They protect ownership of the works and inventions.

Objectives

Students will know key terms: design loop, iterative, scientific method, design log, alternate solutions, brainstorming, design brief, testing, and evaluation.

Students will know engineers use the design loop as a path to solving problems.

Students will know the steps of the design loop.

Students will know how to apply the design loop to a problem.

Students will know how to methodically document work in a design log.

Students will know the attributes of a design log, including consistent use of dates, a pen, cross-out procedures, and blank space.

Students will know that design logs are used in courts to protect inventions.

Students will be skilled at making a design brief, coming up with multiple ideas, evaluating solutions, developing ideas, develop a prototype

Students will be skilled at applying the design loop to problems in class.

Students will be skilled at performing and attributing sources of research.

Students will be skilled at making design log entries that support their classroom work.

Students will be skilled at using unit vocabulary.

Learning Plan

Note: the material in this unit will be in continuous use throughout the year.

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

Conduct formative assessments throughout the process using class discussion, student writing, and practice quizzes.

Assess to determine the students' background knowledge in the design loop and documentation.

Provide guidance and rubrics for the development of written documentation in a design log.

Provide lectures and lessons to develop students' understanding of the design loop.

Provide guidance and rubrics for the development of a digital portfolio.

Complete summative assessments throughout to evaluate skills acquisition.

Conduct formative assessments throughout the design process.

Problem-based learning: Students will develop a solution to a design problem graded with a rubric.

Students and teacher score summative assessments by using a rubric specific to the design problem. Suggested activity: flying device.

Complete unit summative assessments.

Assessment

Formative:

Participate in a guided question and answer sessions, and group and individual discussions, and show an understanding of the purpose of the unit lesson(s), and their key terms and concepts.

Participate in classroom activities such as class discussion, question and answer sessions, cooperative group projects, and presentation of research.

Develop a digital portfolio that logs student activities throughout the year. The portfolio will be graded using a rubric.

demonstrate the ability to utilize the design loop as a problem-solving tool.

Demonstrate the ability to document work in a design log that is assessed with a rubric.

Summative:

Demonstrate the ability to document work in a design log that is assessed with a rubric.

Demonstrate understanding through written quizzes and tests about subject materials.

Meaningfully address the essential and guiding questions of this unit of study.

Benchmark:

Develop a digital portfolio that logs student activities throughout the year. The portfolio will be graded using a rubric.

Maintain a design log throughout the year.

Final project

Final exam

Alternative:

Oral exam

Project review

Materials

Textbook: Raymond B. Landis, Studying Engineering: A Road Map to a Rewarding Career (4th ed.). Discovery Press (ISBN-10: 0879348749, ISBN-13: 978-0979348747)

Robotics Lab, including: soldering irons, electric and manual drills/drill press, scroll saw, hand powered saws,

3-D printer and curing machine, safery glasses, hand operated tools like tin snips, wire cutters, electronic multi meters, power supplies, electronic components.

Computer Lab: Windows based computers with Autocad software, Arduino software, LEGO NXT software, CREO software, INTERNET connectivity.

Consumable materials: materials for 3d Printer, paper, wire, electronics components (speakers, transistors, capacitors, resistors etc).

White Board/LCD Screen

Online references from NJIT