Unit 04: Engineering Graphics and 3d Modeling

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **6 Weeks**
Status: **Published**

Summary

Introduction: Students will develop their knowledge and skills in engineering graphics. Students will use computer software to develop 3D drawing files for use with a 3D printer. Students will make drawings that demonstrate an understanding of units, dimensioning and tolerances. Students will also explore mechanical advantage and simple machines.

Revision Date: July 2022

Standards

9.1.2.CAP	Career Awareness and Planning
	Different types of jobs require different knowledge and skills.
9.1.2.CAP.1	Make a list of different types of jobs and describe the skills associated with each job.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
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).
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
	Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.
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.K-12.1.4	Innovative Designer
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.
9.4.12.IML	Information and Media Literacy
	Digital tools such as artificial intelligence, image enhancement and analysis, and sophisticated computer modeling and simulation create new types of information that may have profound effects on society. These new types of information must be evaluated carefully.
8.1.12.AP.4	Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue.
ED	Engineering Design

	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.
	Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.
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.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
NT	Nature of Technology
	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.
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.
HS-PS2-3	Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
HS-ETS1	Engineering Design
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.
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.
	Using Mathematics and Computational Thinking
ETS1.B	Developing Possible Solutions

Essential Questions/Enduring Understandings

Essential Questions:

How do engineers communicate?

What are technical drawings and the requirements of these drawings?

What is a mechanical advantage?

What are simple machines?

Essential Understandings:

Engineers using graphic conventions as a common visual language

Technical drawings are measured and convey specific information about things, like material, finishes, and dimensions.

Drawings are produced that can be used with 3-D printers in addition to classic paper plotters.

Solutions to engineering problems are often conveyed using drawings.

Mechanical advantage is about trading effort for distance.

Simple machines change mechanical advantage.

Objectives

Students will know key terms: isometric, perspective, oblique, tolerance, maximum material condition, scale, detail, line types, .stl file format, gear, idler gear, compound gear system, simple gear system, and drive/driven.

Students will know engineers use different types of graphic software, each suited to different disciplines and trades.

Students will know units are country and trade-specific.

Students will know how to view a selection, fundamental views of edges and planes for visualization

Students will know conventions for lines, freehand sketching techniques, coordinate space in 3 dimensions.

Students will know what mechanical advantages is.

Students will know the six types of simple machines: The lever, the inclined plane, the screw, the wedge, wheel and axle, and pulley.

Students will be skilled at size and location dimensions, detail dimensions, and dimensioning techniques.

Students will be skilled at making 3D drawings for printing in the 3D printer.

Students will be skilled at reading drawings.

Students will be skilled at using unit vocabulary.

Students will be skilled at making technological products on a 3D printer.

Students will be skilled at identifying simple machines.

Students will be skilled at performing mechanical advantage ratio calculations, and simple and compound gear

system calculations.

Learning Plan

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 electrical engineering.

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

Students will develop their knowledge and skills in engineering graphics.

Students will develop drawings that meet the requirements of a rubric demonstrating proficiency in 2D and 3D technical drawings.

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. Hands-on activity: students will produce 3D interchangeable parts from their drawings. These parts may include simple machines. Possible projects: a pinball machine that incorporates levers, a vehicle with a gear system, and a timer with a gear system.

Students and teacher will score summative assessments using a rubric specific to the design problem.

Complete unit summative assessments.

Assessment

Formative:

Participate in guided question and answer sessions, 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.

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.

Students and teacher will score summative assessment using a rubric specific to the design problem.

Benchmark:

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

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, safety glasses, hand-operated tools like tin snips, wire cutters, electronic multimeters, power supplies, and electronic components.

Computer Lab: Windows-based computers with Autocad software, Arduino software, LEGO NXT software, CREO software, and 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