Unit 3: CADD and 3-D Printing

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **3-4 weeks**
Status: **Published**

Summary

Introduction:

Students will develop 3-D drawings for objects to be produced on a 3-D printer. The objects will be printed and studied. Students will become skilled at making and reading CAD engineering drawings. Students will explore conventions used in making orthographic projection drawings. Students will use commands (LINE, CONSTRUCTION LINE, OFFSET) and dimension the drawings using trade-appropriate units. Students will also use AutoDesk and other software to create drawings for the 3-D printer in the .stl format.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions:

Why are standardized conventions and symbols essential for creating clear, unambiguous working drawings that can be understood universally?

How does the process of creating working drawings translate a conceptual design into a set of instructions that can be accurately manufactured?

Beyond drawings, what are the critical components of a comprehensive technical project document, and why is this documentation vital for project continuity and future improvements?

How does effective project documentation mitigate risk, ensure intellectual property rights, and support legal compliance?

How does an engineer's choice of drawing type—such as schematic, assembly, or part drawings—depend on the specific purpose and audience of the document?

How does the design process for 3D printing, which often uses solid models, differ from traditional 2D drawing methods, and what new challenges does this present?

Enduring Understandings:

Engineers make orthographic drawings, and they adhere to conventions

Engineers make drawings for different purposes (i.e., production, documentation, 3-D printing).

Engineers make drawings that use units that relate to trades.

Objects produced can be developed.

Objectives

Students will know:

How to start a new drawing and save it in CAD.

How units are determined and used in CAD.

How to use basic functions in CAD: line, linetype, arc, circle, rectangle, chamfer, fillet, erase, trim.

How to use dimensions in CAD.

How to effectively use dimensions and precision when describing an object.

How to use a high-precision caliper for measuring parts.

How to approach making interchangeable parts.

How to evaluate tolerances in a drawing.

How to create and organize orthographic drawings.

Some professions that use engineering graphics.

vocabulary: tolerance, units, construction line, object line, line weight, dimension line, dimension extension line, .dwg, .stl, front, top, side.

Students will be skilled at:

making orthographic drawings of an object

making .stl drawings of an object that can be printed on a 3-D printer

evaluating products made with a 3-D printer

Learning Plan

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

Formative assessments will be conducted throughout the process using class discussion, and practice quizzes.

Formative assessments will be conducted throughout the design process.

Teacher will provide demonstration using Smartboard of fundamental concepts of making an orthographic drawing.

Teacher to lecture on how to use a 3-D printer, including slicer software, calibration, loading and unloading.

Suggested activity: provide students with a 3 dimensional drawing with dimensions. Students will create orthographic drawings.

Suggested activity: provide students with a set of parts that need a chassis, i.e. 2 servo motors and an Arduino. Students will make a .stl of the mounting system and print it.

Lecture: careers that involve 3D printing

Suggested activity: a chassis for a bluetooth speaker

Suggested activity: a mount for a sensor (i.e. a distance sensor) to be used in a game

Suggested activity: Project based learning: provide students with a design problem like make a tablet holder from recycled materials. Students will make the product and orthographic drawings.

Current Events: identify trends in 3-D printers

Summative assessments will be conducted throughout to evaluate skills acquisition.

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 discussions on 3-D printers, 3-D drawings, and Arduino

accurate use of unit vocabulary

exit tickets

individual check-ins with the teacher that provide feedback

Summative Assessment:

students will make orthographic drawings. The project will be graded using a rubric.

students will make still drawings. The project will be graded using a rubric.

Complete writing prompts: Why does engineering make orthographic drawings? What are the concerns regarding size and tolerancing when making a .stl drawing?

answer the essential questions.

complete a project with 3-D printer-produced components

Alternate Assessment:

Presentation on using CAD with a drawing example following the given parameters

Benchmark Assessment:

Evaluation: final exam

Materials

CAD and other software programs

3-D printer and supplies

Safety glasses

INTERNET resources and tutorials on how to use CAD software.

Teacher e-board.

SmartBoard use for teacher presentation and interactive lessons

SmartBoard use for student presentations.

Model making materials, dependant on projects that used.

Standards

9.4.12.CI	Creativity and Innovation
9.2.12.CAP	Career Awareness and Planning
L	Language
L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
	With a growth mindset, failure is an important part of success.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

	Innovative ideas or innovation can lead to career opportunities.
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).
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
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.
9.4.12.CT	Critical Thinking and Problem-solving
	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).
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).
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.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.
LA.WHST.9-10	Writing History, Science and Technical Subjects
	Text Types and Purposes
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.
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.
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.
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.
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.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
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).
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).
HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
ESS3.A	Natural Resources
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ETS1	Engineering Design
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.

Integrated Accommodations 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