Unit 05: 3D Printing and Model Making

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 2**
Length: **4 Weeks**
Status: **Published**

Summary

Students will develop skills in prototyping and architectural model-making. Students will develop knowledge of 3D files of their own design and print them on the 3-D printer. Students will use AutoCAD, and CREO to make files and slicer software to generate machine-ready files. File types (.stl, .dwg), scale, metric & English units will be explored. Students will also use traditional tools in the classroom to make design prototypes. Safety topics appropriate to the tools in use will be reviewed. Sanitation topics related to the Resin printer will be discussed.

Revision Date: July 2023

Essential Questions/Enduring Understandings

Essential Questions

How do models and prototypes relate to the design loop?

Who is the audience for the model or prototype?

What is the purpose of the object being produced?

Enduring Understandings

A model is a representation while a prototype may be a final product.

A model is an effective, easily understand method of communication.

Objectives

Students Will Know:

Key terms: prototyping, proportion, chipboard, scale, balance, harmony. 3-D printer specific terminology: resin, resin printer, filament, .stl, slicer software.

units of measure: metric and imperial.

what is meant by scale and how it relates to model making.

how models are used throughout the design of a building.

how to create presentation models that have the aesthetic requirements to communicate effectively.

how to choose materials for a model that will communicate the essential concept of the building.

safety and sanitation procedures when using a resin printer, power, hand tools, an X-acto knife, and other tools.

what materials are used to create models (such as chipboard and foam core) and why.

how to make a model.

how to document their work and include it in a digital portfolio.

Students Will Be Skilled At:

making models with 3-D printers.

making models using tools in the CADD lab.

working with computer files from different products and making them work together.

following safety and sanitation procedures.

determining the attributes of models dependant on their purpose.

making prototypes.

Learning Plan

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

Lecture and discussion about guiding questions: When do we use models in the design of a building? What is the difference between a model and a prototype? Could we use models to study a system or component of a building and why would we want to do this? What does a presentation model have in common with a presentation drawing? What are the advantages and disadvantages of models over drawings?

Students will research (museum, library, Internet) and report and/or create a presentation on model-making techniques and materials.

Formative assessments will be conducted throughout the process.

Teacher will demonstrate and involve students in discovering techniques for making a model.

Teacher will demonstrate how to safely use tools and equipment in the CADD lab. (See Unit 1 Safety).

Teacher will lecture on how the chain of events of making a file to making a 3D print.

Students make a model for a building from a previous project.

Students make a prototype of an object of their own design.

Students will incorporate images of their objects into a digital portfolio.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Complete the writing prompts.

Materials

Materials:

Computer lab with AutoCAD software, one computer per student

White board with projector or Smartboard

CADD Lab including 3d printers, drill press, scroll saw and power drill, soldering iron, xacto knives, and hand tools.

Standards

LA.RH.9-10	Reading History and Social Studies
TECH.K-12.1.1.a	articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
TECH.K-12.1.1.c	use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
LA.RH.9-10.3	Analyze in detail a series of events described in a text; draw connections between the events, to determine whether earlier events caused later ones or simply preceded them.
	Craft and Structure
TECH.K-12.1.1.d	understand the fundamental concepts of technology operations, demonstrate the ability

	to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.
LA.RH.9-10.4	Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history and the social sciences; analyze the cumulative impact of specific word choices on meaning and tone.
	Integration of Knowledge and Ideas
TECH.K-12.1.2.d	manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.
TECH.K-12.1.3	Knowledge Constructor
	Range of Reading and Level of Text Complexity
TECH.K-12.1.3.a	plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
LA.RH.9-10.10	By the end of grade 10, read and comprehend history/social studies texts in the grades 9-10 text complexity band independently and proficiently.
LA.RST.9-10	Reading Science and Technical Subjects
TECH.K-12.1.3.c	curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
TECH.K-12.1.3.d	build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
TECH.K-12.1.4	Innovative Designer
	Craft and Structure
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.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
TECH.K-12.1.4.c	develop, test and refine prototypes as part of a cyclical design process.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
LA.RST.9-10.6	Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
	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.
	Range of Reading and Level of Text Complexity
LA.RST.9-10.10	By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
TECH.K-12.1.6	Creative Communicator
TECH.K-12.1.6.a	choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
TECH.K-12.1.6.b	create original works or responsibly repurpose or remix digital resources into new creations.
TECH.K-12.1.6.c	communicate complex ideas clearly and effectively by creating or using a variety of digital

	objects such as visualizations, models or simulations.
TECH.K-12.1.6.d	publish or present content that customizes the message and medium for their intended audiences.
SCI.HS-ETS1	Engineering Design
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.C	Optimizing the Design Solution
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.
	Systems and System Models
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.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.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.
CS.9-12.8.2.12.NT.1	Explain how different groups can contribute to the overall design of a product.
CS.9-12.8.2.12.NT.2	Redesign an existing product to improve form or function.
CS.9-12.ED	Engineering Design
CS.9-12.NT	Nature of Technology
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.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.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
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.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	Digital Citizenship

TECH.9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
	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.
	With a growth mindset, failure is an important part of success.
	Innovative ideas or innovation can lead to career opportunities.
	Cultivating online reputations for employers and academia requires separating private and professional digital identities.
	Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.
	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.
	Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.
	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.

Assessment

Formative

Meaningfully address the essential questions and enduring understandings of this unit of study.

Meaningfully 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.

Complete the writing prompt. Example: We used models to study: the effect of the sun, or how the steel was expressed in the façade or the proportions of the roof…

Exit Ticket

Summative

Create a model for a previous project that demonstrates the principles explored in this unit including material selection, quality of craft, and safety. Presentation to be evaluated using teacher and student-designed rubrics.

Create a prototype that demonstrates the principles explored in this unit including material selection, quality of craft, and safety. Presentation to be evaluated using teacher and student-designed rubrics. Demonstrate through practice the use of 3D printers and software to run them.

The presentation will be included in an electronic portfolio.

Benchmark

Midterm Exam/Final Exam

Alternative Assessment

Observe and analyze professionally made models and describe their characteristics.

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

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk Students, Gifted and Talented students, Career Education, and those with 504s