

Engineering Design

Hillcrest High School (054677)

**Modeled Course
Outside District
Approved**

Mar 10, 2020
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Basic Course Information

Title:	Engineering Design
Transcript abbreviations:	CAD 1
Length of course:	Full Year
Subject area:	Visual & Performing Arts (F) / Visual Arts
UC honors designation?	No
Prerequisites:	Algebra (Recommended)
Co-requisites:	None
Integrated (Academics / CTE)?	Yes
Grade levels:	9th, 10th, 11th, 12th
Course learning environment:	Classroom Based

Course Description

Course overview:

Engineering Design or CAD Engineering(Computer Aided Design) is an introductory course for students interested in developing primary skills in the area of Engineered Drafting and Design. The curriculum will provide students with a practical and theoretical perspective of the visualization techniques used by contemporary and historical product designers and engineers. This includes freehand sketching, technical sketching, digital rendering, information and perspective graphics, and presentation skills. Students will learn how to model and design three-dimensional objects based on 2D drawings using engineering modeling software. Students will develop and apply knowledge of elements, principles, and concepts of art, science, design, and aesthetics. Students will learn about postsecondary requirements for careers related to Engineering and Computer-Aided Design. Students will be required to work both in teams and individually to solve mechanical issues, create drawings of ideas, and produce their own product and personal brand. Class activities will involve research, history, presentations, sketching, dimensioning, notations, sectional plans, 3D printing and other phases of Engineering Design and development.

Course content:

Unit One: The Nature of Design

In this introductory unit, students learn about the elements, principles and concepts of art, design, aesthetics while developing and refining their sketching skills. They will apply these skills to proportionally sketch a variety of engineering models and proportional shapes. Through lecture and reading assignments, students learn why sketching is an important step in the creation process in this age of computers. They will also experience the evolution of drawing as it relates to ideas, form, function and innovation. They will learn how to incorporate perspective and depth into sketches and acquire the vocabulary essential to communicate in the realm of art and engineering design. Students will develop their artistic perception and creative expression through the development of 5 basic drawing skills: 1) The perception of edges, 2) the perception of spaces, 3) the perception of relationships, 4) the perception of lights and shadows, 5) the perception of the whole. As students work through this unit, they will interpret the development of graphic language in relation to engineering design. They will begin the process of peer review critiques.

Unit Assignment(s):

Key Assignments:

- Apply sketching techniques to a variety of engineering models and proportional shapes.
- Produce proportional two- and three-dimensional sketches and designs.
- Final Unit Project - Create a freehand graphical element that depicts the elements of art and principles of design while incorporating the elements of art and principles of design.
 - Present to class with a discussion about how the principles of design were used.
 - Students will individually describe the principles of design used in each work reviewed, focusing on dominance and subordination.
 - Identify and use the principles of design to discuss, analyze, and write about visual aspects in the environment and in works of design, including the student's own work.

Literacy Component

TECHNICAL GRAPHICS COMMUNICATIONS, FOURTH EDITION

Chapter 1-4

Unit Two: The History of Design

In this unit, students will gain historical and cultural context through the study of the importance of art in engineering through the works of artists/engineers such as Ub Iwerks. They will gain an understanding of historical and current events related to engineering design and their effects on society. They will interpret the development of graphic language in relation to engineering design.

Unit Assignment(s):

Key Assignments:

- *Research artists and engineers in history. Develop and present a lesson about the person. Included in presentation a sketch done by the student that mimics the work of the artist/engineer.*
- Write a reflective paper that explains the contribution of a chosen artist/engineer. Talk about challenges faced as well as benefits to society of the invention.

Unit Three: The Digital Depiction of Design

In this unit, students will go from concept sketches to computerized models. Students will be introduced to the concept of the “nonverbal language of art”. They will use sketches and models to communicate shapes and lines within a space. Using hand sketching and engineering modeling software, students will practice drawing the two-dimensional top, front and right side planes of a three-dimensional object. Students will understand measurement systems as they apply to engineering design. They will learn the degree of accuracy necessary for engineering design.

Unit Assignment(s):

Key Assignments:

- Students will create several basic shape models. Through this they will learn to use the features that are most often manipulated when creating 3d shapes. Students will set up relationships with each model and check clearances. They modify each part to resolve clearance issues.
- Students will utilize basic shape models, volume, and size constraints to produce a breast cancer awareness medallion. The medallion will be 3d printed and used to assess students’ understanding of spatial awareness.
- Portfolio: Students will keep a portfolio of original two- and three-dimensional works that reflect developing craftsmanship and technical skills. Each piece should include a form that defines observational drawing skills and how they were applied by student.

Literacy Component

TECHNICAL GRAPHICS COMMUNICATIONS, FOURTH EDITION**Chapter 5-7****Unit Four: The Design Challenge**

In this unit, students will practice what they have learned in the completion of a 'minor problem'. Students will communicate, through a detailed set of drawings, a solution to an engineering design problem. The students must be able to justify how their drawings represent their study and understanding of the elements of art and the principles of design along with the types, uses, materials and methods. They will demonstrate their ability to develop orthographic drawings and use orthographic projection to create multi-view drawings. Students will further develop their Aesthetic Valuing skills through their critiques of the 'minor problems' presented by classmates.

Unit Assignment(s):**Key Assignments:**

- Minor Problem Example: Design a cell phone cover that represents the style of either Louise Nevelson or Andy Goldsworthy. Present design to class, being able to describe how the principles of design were implemented in the final solution. Show the progress of your design from rapid visualization drawings to final 3d printed prototype.
- Students critique design solutions from 'minor problem' in class
- Students will write an essay explaining, differentiating, and illustrating isometric views, standard views, dimensions, and their differences.

Literacy Component**TECHNICAL GRAPHICS COMMUNICATIONS, FOURTH EDITION****Chapter 8-10, 12-13****Unit Five: The Design of Models and Prototypes**

In this unit, students will continue to develop skills related to prototyping and model-making for product design. They will deepen their understanding of how static and working prototypes are developed from graphical representations. They will use engineering design equipment appropriately, accurately and safely. Students will gain competence in use of 3D modeling software to create their 2D and 3D sketches They will continue completing peer review critiques

Unit Assignment(s):**Key Assignments:**

- Students will use reverse engineering design to analyze the work of a product designer by taking apart an artifact. Students will write about and present the designer's style and will also identify how the designer used the elements of art

and the principles of design in the creation of the artifact. Students will be required to identify possible artists that might have influenced the designer; students must provide evidence to support their findings.

- Create a prototype of the reverse-engineered design. Rework the model through the knowledge gained from routine student, teacher, and self-reviews and critiques.

Literacy Component

Students will conduct a 2-page research paper using APA style, examining the legal ramifications surrounding the use of reverse engineering. Inclusive in this research paper will be information regarding the legal case which led to engineers using reverse-engineering as a viable means to product development.

Unit Six: Wind Turbine Design

This is a multi-disciplinary unit involving English Language Arts, Biology, Social Science, and Engineering Design. Students will locate a site, then plan and design a viable wind farm. Students will then prototype a .005 scale working wind turbine that will be tested for efficiency. Students will gain an understanding of non-geometric shapes, 3d printing limitations, and ethical design considerations. Students will be introduced to careers in Environmental Engineering, Biology, and Power Engineering through a series of guest speakers. Students will culminate this unit with a presentation of their design and finding before a panel in industry advisors and community members.

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Unit Assignment(s):

Key Assignments:

- Collaborating in groups of four, students will be provided with industry standard maps to analyse wind map data, power transmission line data, and highway/road data. From their analysis, students will develop wind farm site plans that can produce an optimal amount of energy.
- Students will utilize airfoil data to design and 3d print wind turbine blades for a .005 scale wind turbine model. Students will learn about advanced 3d modeling techniques and how they are commonly applied in industry.

Literacy Component

Students will conduct an exploration of post-secondary requirements for careers related to wind power generation and share their findings roundtable discussion of their findings as a class.

Unit 7: Project Designs

In this final unit, students will demonstrate the knowledge gained in the class to use engineering software to refine their reversed engineered design from the last unit. They will learn to use 3d printers to create a prototype of what one aspect of the reverse engineered product. Students will share their reversed engineered product for a final design review by fellow students.

Students will gain an understanding of connections, relationships, and applications by learning how to cost out their designs for production as well as through the creation of a final portfolio of works to be presented for review to classmates, the teacher, and industry partners.

Unit Assignment(s):

Key Assignment:

Create a portfolio of works completed that includes hand and computer drawings of all projects. Portfolio should reflect refined craftsmanship and technical skills. Plan and execute a public exhibition of your work and a reflection on your learning before a panel of industry partners.

College and Career Readiness

(Aspects of college and career readiness are infused throughout the course.)

Career and College Campus Field Trips: Throughout the course, students will participate in career exploration through engineering and design related field trips, job shadowing and other course-embedded work-based learning with the goal of increasing career knowledge. Students will also prepare for postsecondary education through university and college campus visitations and research related to college majors and certification programs in engineering and design.

Unit Assignment(s):

Resume and Cover Letter: After reviewing resume and cover letter exemplars and researching trends in professional resume writing, students develop and/or revise a professional resume and cover letter. This resume will be reviewed by one or more industry partners prior to inclusion in the student's portfolio. E-mentors and members of the academy/pathway advisory board will serve as resume advisers and provide feedback to support high quality resumes. The Resume and Cover Letter are then included in the student's portfolio of work.

Course Materials

Textbooks

Title	Author	Publisher	Edition	Website	Primary
TECHNICAL GRAPHICS COMMUNICATION	Bertoline	McGraw Hill	4th Edition/2017	https://www.amazon.com/Technical-Graphics-Communication-Robert-Bertoline/dp/0077221303	Yes
Autodesk Inventor 2020 and Engineering Graphics	Randy H. Shih	SDC Publications	1st/2019	https://www.sdcpublications.com/Textbooks/Autodesk-Inventor-2020-Engineering-Graphics/ISBN/978-1-63057-283-9/	No

Other

Title	Authors	Date	Course material type	Website
Autodesk Inventor 2020	Autodesk	2020	Software	autodesk.com
Fusion F410	Fusion3	September, 2019	3D Printer	https://www.fusion3design.com/
Simplify3D	Simplify3D	02/07/2020	Software	https://www.simplify3d.com/

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