

Project Lead the Way - Introduction to Engineering Design Course Description TEC 151/152

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Course Website

www.shsteched.com

Course Overview

Introduction to Engineering Design (IED) is a high school level course that is appropriate for students who are interested in design and engineering. The major focus of the IED course is to expose students to the design process, research and analysis, teamwork, communication methods, global and human impacts, engineering standards, and technical documentation. IED gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APPB) learning. Used in combination with a teaming approach, APPB-learning challenges students to continually hone their interpersonal skills, creative abilities and understanding of the design process. It also allows students to develop strategies to enable and direct their own learning, which is the ultimate goal of education.

Introduction to Engineering Design is one of three foundation courses in the Project Lead The Way high school pre-engineering program. The course applies and concurrently develops secondary level knowledge and skills in mathematics, science, and technology.

Course Objectives

At the end of this course, students will be able to:

- Demonstrate an understanding of the engineering design process and how engineers use it to solve problems.
- Discuss the different fields of engineering and their roles.
- Use measurement and statistics to analyze the creation of a product.
- Calculate area, volume, and weight of three-dimensional solids.
- Generate and document ideas through brainstorming.
- Use different types of sketches to share and document ideas.
- Create sketches and solve problems using Computer Aided Drawing (CAD) software.
- Work effectively in a team to solve a design challenge.

Required Supplies Engineering Notebook



Pencil and Pen Flash Drive School Google Account Headphones

Specific Course Activities

All students will be expected to:

- Maintain an engineering notebook based on the Project Lead the Way standards.
- Complete assignments in their notebooks and using our Autodesk Inventor software.
- Maintain a course long portfolio showcasing assignments from each unit.
- Work alongside classmates to complete a variety of design challenges.

Course Outline

- Unit 1 Design process
- Unit 2 Technical Sketching and Drawing
- Unit 3 Measurement and Statistics
- Unit 4 Modeling Skills
- Unit 5 Geometry of Design
- Unit 6 Reverse Engineering
- Unit 7 Documentation
- Unit 8 Advanced Computer Modeling
- Unit 9 Design Teams
- Unit 10 Design Challenges

Expectations

All students are expected to follow the guidelines as set in the Stevenson High School Student Guidebook, as well as ones set in each individual class.



Evaluation

<u>At the end of the semester</u> each student's final grade will be a composite ranking in each of the course standards. The teacher will use the double majority matrix to make a professional decision based on evidence for the final grade of each standard:

Standards Grading Matrix			
Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
EM, M	AM, EM	AM, M	SD, EM
EM, AM	M, AM	AM, SD	SD, M
M, EM	EM, SD	M, SD	SD, AM

The composite rankings and following course mastery grade calculation rules will be used to determine the student's semester grade: (Note: rankings of "EM" and "SD" are used to determine "+" or "-" within each grade level).

А	Mastery in 4 standards
В	Mastery in 3 standards
С	Mastery in 2 standards
D	Mastery in 1 standards
F	Mastery in 0 standards

Course Standards and Objectives

Science and Math

1.1 I can calculate physical properties of an object.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can consistently and accurately calculate the physical properties of simple and composite objects to guide design decisions.	I can accurately calculate the physical properties of simple and composite objects.	I can calculate the physical properties of simple objects.	With help, I can calculate the physical properties of simple and composite objects.

- Accurately calculate/measure the <u>density</u> of simple and composite objects (complex objects)
- Accurately calculate/measure the <u>weight</u> of simple and composite objects (complex objects)
- Accurately calculate/measure the <u>mass</u> of simple and composite objects (complex objects)



1.2 I can calculate the geometric properties of shapes/solids.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can consistently and accurately calculate the geometric properties of simple and composite shapes/solids to guide design decisions.	I can accurately calculate the geometric properties of simple and composite shapes/solids.	I can calculate the geometric properties of simple shapes/solids.	With help, I can calculate the geometric properties of simple shapes/solids.

Mastery Criteria:

- Accurately calculate the <u>area</u> of simple and composite shapes (complex shapes)
- Accurately calculate the <u>surface area</u> of simple and composite solids (complex solids)
- Accurately calculate the <u>volume</u> of simple and composite solids (complex solids)

1.3 I can make linear measurements of an object or distance.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can consistently make accurate linear measurements of real world and 2D objects/distances to guide design decisions.	I can consistently make accurate linear measurements of real world and 2D objects/distances.	I can make linear measurements of real world and 2D objects/distances.	With help, I can accurately make linear measurements of real world and 2D objects/distances.

Mastery Criteria:

- Consistently make accurate linear measurements of real world and 2D objects using an Engineering Scale
- Consistently make accurate linear measurements of real world and 2D objects using a <u>Dial</u>
 <u>Caliper</u>

1.4 I can calculate statistics of different data sets.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can accurately and consistently calculate the statistics of a data set to guide design decisions.	I can accurately and continuously calculate the statistics of a data set.	I can calculate statistics of a given data set.	With help, I can calculate statistics of a given data set.

Mastery Criteria:

- Accurately calculate the <u>mean</u> for given data set.
- Accurately calculate the median for given data set.
- Accurately calculate the mode for given data set.
- Accurately calculate the range for given data set.
- Accurately calculate the standard deviation for given data set.
- Create graphs to show data. (Histograms and Dot Plots)

1.5 I can convert units using the SI and the US Customary measurement systems.



Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can accurately and consistently convert units using the SI and US Customary measurement systems to guide design decisions.	I can accurately and consistently convert units using the SI and US Customary measurement systems.	I can convert units using the SI and US Customary measurement systems.	With help, I can convert units using the SI and US Customary measurement systems.

Mastery Criteria:

- I can accurately and consistently convert units within the <u>SI measurement</u> system.
- I can accurately and consistently convert units within <u>US Customary measurement system</u>.
- I can accurately and consistently convert units <u>between the SI and US Customary measurement</u> <u>system</u>.

Technology

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Exceeding Mastery	Mastery	Approaching Mastery	Still Developing	
I can use CAD software to create fully defined basic shapes that have multiple basic geometric features, meet specific design requirements, and to guide design decisions.	I can use CAD software to create fully defined shapes that have multiple basic geometric features and meet specific design requirements.	I can use CAD software to create fully defined basic shapes.	With help, I can use CAD software to create fully defined basic shapes.	

Mastery Criteria:

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- Authentic shapes
 - Additive and subtractive modeling
 - Extrude (cut, join, intersect)
 - Revolve
 - Loft
 - Sweep
- Modify Features
 - Emboss
 - Hole
 - Fillet
 - Chamfer
 - o Shell
 - Thread
 - Work Features
 - Planes
 - Axis
 - Point
 - Assign a Material
- Pattern
 - Mirror
 - Circular



- Rectangular
- Sketch Techniques

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- $\circ \quad \text{Drawings Tools} \\$
- Dimension and Geometric Constraints
- Patterns
- Format Tools
- Modify Tools

2.2 I can use CAD software to create working drawings.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can use CAD software to create detailed working drawings that follow ANSI standards.	I can use CAD software to create detailed working drawings.	I can use CAD software to create working drawings.	With help, I can use CAD software to create working drawings.

- Completed Title Block
 - Place Annotations
 - Dimensions
 - Linear (Single)
 - Baseline Set
 - Feature Notes
 - Hole and thread
 - Chamfer
 - Fillet
 - Symbols
 - Centerline
 - Center Mark
 - Text
- Place Views
 - Base
 - Projected
 - Auxiliary
 - \circ Section
 - Detail
 - o Break
 - Break Out
 - Explosion
 - Balloons
 - Parts List



2.3 I can use CAD software to create assembly files.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can use CAD software alongside video editing software to create a visually appealing video presentation that shows the different features of my design.	I can use CAD software to create fully constrained assembly files.	I can use CAD software to create a video presentation that shows the different features of my design.	With help, I can use CAD software to create a video presentation that shows the different features of my design.

Mastery Criteria:

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- Authentic shapes
- Assembly Constraints
 - Mate
 - Angel
 - Tangent
 - Insert
 - Symmetry
 - Motion Constraints
 - Rotation
 - $\circ \quad \text{Rotation-Translation}$

2.4 I can use CAD software to create animations and presentations of my design.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can use CAD software alongside video editing software to create a visually appealing video presentation that shows the different features of my design.	I can use CAD software to create a visually appealing video presentation that shows the different features of my design.	I can use CAD software to create a video presentation that shows the different features of my design.	With help, I can use CAD software to create a video presentation that shows the different features of my design.

- Renderings
 - Animation
 - Pictures
- Presentations (Exploded View)
 - Create View
 - Tweak Components
 - Record and Export a Quality Video File



2.5 I can use CAD software to analyze the physical properties of a 3D model.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can use CAD software to accurately analyze the physical properties of a shape and use the information to guide design decisions.	I can use CAD software to consistently and accurately analyze the physical properties of a shape.	I can use CAD software to accurately analyze the physical properties of a shape.	With help, I can use CAD software to analyze the physical properties of a shape.

Mastery Criteria:

- Mass
- Surface Area
- Volume
- Principal Moments
- Center of Gravity
- Density
- Stress Analysis

Engineering

3.1 I can identify and analyze the responsibilities of different engineering disciplines.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can analyze a process or product and identify and describe how multiple engineering disciplines are responsible for a products development.	I can analyze a process or product and identify and describe the engineering disciplines responsible for their development.	I can identify and describe the different engineering disciplines.	I can identify the different engineering disciplines.

3.2 I can use sketching techniques to create and document solutions to a given problem.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can consistently and accurately use sketching techniques to create detailed sketches that document solutions to a given problem and guide design decisions.	I can consistently use sketching techniques to create pictorial sketches of a given object.	I can use sketching techniques to create pictorial sketches of a given object.	With help I can use sketching techniques to create pictorial sketches of a given object.

- Line Conventions
- Annotated



- Tonal Shading
- Proportions
- Oblique
- Isometric
- 1 Point Perspective
- 2 Point Perspective
- Multiview Drawing Techniques
 - All orthographic projections (Top, Bottom, Front, Back, Left, Right)
 - Line Conventions
 - Hidden Lines
 - Centerlines
 - Extension Lines
 - Dimension Lines
 - Leader Lines
 - Place Annotations
 - Dimensions
 - Linear (Single)
 - Baseline Set
 - Feature Notes
 - Hole
 - Thread
 - Chamfer
 - Fillet
 - Symbols • Centerline
 - Center Mark

3.3 I can use an engineering notebook to document the design process.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can use an engineering notebook to clearly and accurately document the design process in and outside the scope of the class according to established engineering standards.	I can use an engineering notebook to clearly and accurately document the design process according to established engineering standards.	I can use an engineering notebook to document the design process.	With help, I can use an engineering notebook to document the design process.



3.4 I can use the engineering design process.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can continuously use the engineering design process to create a unique solution as well as test, evaluate, and use feedback to improve my design to meet the requirements of a given problem.	I can use the engineering design process to test, evaluate, and use feedback to improve my design and to meet the requirements of a given problem.	I can use the engineering design process to create a design that meets some of the requirements of a given problem.	I can use the engineering design process to create a design that attempts to meet the requirements of a given problem.

Mastery Criteria:

- Define the Problem
- Generate Concepts (Brainstorming)
- Develop a Solution
- Construct and Test a Prototype
 - Modeling Techniques
- Evaluate Solution
- Present Solution

3.5 I can critique, review and evaluate engineering designs.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I can analyze and critique a engineering design to provide valuable and detailed feedback to the design's engineer by identifying specific problems and telling them how to improve it.	I can analyze and critique an engineering design to provide valuable and detailed feedback to the design's engineer.	I can analyze and critique a engineering design to provide feedback to the design's engineer	With help, I can analyze and critique a engineering design to provide feedback to the design's engineer

- Identify Principles and Elements of Design
- Visual Analysis
- Functional Analysis
- Structural Analysis



4.1 I can manage my time in Introduction to Engineering Design.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I consistently manage my time and help my peers to stay on task and meet deadlines by using project management strategies and tools.	I consistently manage my time to stay on task and meet deadlines by using project management strategies and tools.	I occasionally manage my time to stay on task and meet deadlines by using project management strategies and tools.	With help, I manage my time to stay on task and meet deadlines.

4.2 I demonstrate commitment to team goals.

Exceeding Mastery	Mastery	Approaching Mastery	Still Developing
I consistently demonstrate commitment to team goals by positively accepting responsibilities, consistently completing tasks, encouraging participation of all team members and voluntarily assisting others as needed while inviting feedback received by others.	I consistently demonstrate commitment to team goals by positively accepting responsibilities, consistently completing tasks and voluntarily assisting others as needed.	I demonstrate commitment to team goals by positively accepting responsibilities, completing tasks and voluntarily assisting others as needed most of the time.	With help, I accept responsibilities and complete assigned tasks.