

Course Title:	Engineering Design and Development (EDD) - Project Lead the Way (PLTW)
Department:	Career Technical Education
Course Number:	2447
Grade Level/s:	11-12
Length of Course:	Year
Prerequisite/s:	Successful completion of Introduction to Design-Engineering (IED) and Principles of Engineering (POE)
UC/CSU (A-G) Req:	G (Pending)
Brief Course Description:	Engineering Design and Development (EDD) is a capstone course of the engineering pathway. The knowledge and skills students acquire throughout PLTW Engineering Pathway come together in this course as students identify a real-world issue or challenge. Students will research, design and test a solution to the issue or challenge. Students will present the real-world challenge and associate solution to a panel of engineers. Students will apply the professional skills from the documentation of the design process as they enter a post-secondary program or career.

I. GOALS

The students will:

- A. Understand the steps of a design process to include technical communication and project management.
- B. Generate problem statements aligned with identified problems written in a concise and accurate manner.
- C. Justify the problem that will be used in the engineering design process and its solution.
- D. Collaboratively solve a problem that focuses on research, development and marketing of new products.
- E. Investigate current and past solutions to problems and determine if innovation or a new invention is warranted.
- F. Invent or innovate using: goal-directed research, creative thinking, economic and cultural influences.

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- G. Define product specifications for a design solution.
- H. Use a decision matrix to evaluate a design solution.
- I. Use optimization to improve a final design solution.
- J. Develop and use technical sketches and drawings to complete and refine a design solution.
- K. Build a prototype with available equipment using tool machine safety, step-by-step instructions and material and cost analysis.
- L. Develop a test method using a specific criteria for success or failure.
- M. Use the results of prototype testing to evaluate aspects of a design solution for product improvement.
- N. Utilize a valid testing procedure for a design solution in order to evaluate results for accuracy and repeatability.
- O. Use various media formats to communicate the design solution process.
- P. Develop and utilize a technical report to provide thorough communication of all aspects of the design process and project.
- Q. Develop and present a final design project to include content of the design process, project implementation knowledge and skills gained through the project.
- R. CTE Model Standards:
The students will:
 - 1. Apply appropriate technical skills and academic knowledge.
 - 2. Communicate clearly, effectively, and with reason.
 - 3. Develop an education and career plan aligned with personal goals.
 - 4. Apply technology to enhance productivity.
 - 5. Utilize critical thinking to make sense of problems and persevere in solving them.
 - 6. Act as a responsible citizen in the workplace and the community.
 - 7. Model integrity, ethical leadership and effective management.
 - 8. Work productively in teams while integrating cultural and global competence.
 - 9. Demonstrate creativity and innovation.
 - 10. Employ valid and reliable research strategies.
 - 11. Understand the environmental, social, and economic impacts of decisions.
 - 12. Demonstrate sketching process used in concept development.
 - 13. Employ the design process to solve analysis and design problems.
 - 14. Understand industrial engineering processes, including the use of tools and equipment, methods of measurement, and quality assurance.
 - 15. Understand fundamental control system design and develop systems that complete preprogrammed tasks.
 - 16. Understand the fundamentals of systems and market influences on products as they are developed and released to production.
 - 17. Design and construct a culminating project effectively using engineering technology.

II. OUTLINE OF CONTENT FOR MAJOR AREAS OF STUDY

Semester 1

- A. Unit 1: Course Introduction
 - 1. Lesson 1.1 Introduction to Engineering Design and Development
- B. Unit 2: Problem Identification
 - 1. Lesson 2.1 Introduction to Problem Statement
 - 2. Lesson 2.2 Verify and Justify the Problem
- C. Unit 3: Research
 - 1. Lesson 3.1 Research and Development
 - 2. Lesson 3.2 Investigate Current and Past Solutions
 - 3. Lesson 3.3 Invent or Innovate
- D. Unit 4: Decision Process
 - 1. Lesson 4.1 Defining Product Specifications
- E. Unit 5: Design
 - 1. Lesson 5.1 Sketching and Technical Drawings

Semester 2

- A. Unit 6: Build
 - 1. Lesson 6.1 Building a Prototype
- B. Unit 7: Test
 - 1. Lesson 7.1 Test Method
 - 2. Lesson 7.2 Test Designed Solution
- C. Unit 8: Presentation
 - 1. Lesson 8.1 Project Documentation
 - 2. Lesson 8.2 Juried Presentation

II. ACCOUNTABILITY DETERMINANTS

- A. Key Assignments
 - 1. Unit 1: Course Introduction
 - Create an engineer's notebook to chronologically document all aspects of a design project and process.
 - 2. Unit 2: Problem Identification
 - Develop an accurately written problem statements identifying needs that guide the design process.
 - 3. Unit 3: Research
 - a. Conduct research using assessment techniques, such as trend analysis, to determine if a solution should be designed for development.
 - b. Sketch one invention and one innovation related to the problem.
 - 4. Unit 4: Decision Process
 - a. Create a description of the product specifications for the design solution.

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- b. Evaluate proposed design solutions using specific criteria.
- c. Select the best design solution and graphically represent the results.
- 5. Unit 5: Design
 - a. Sketch all parts of a design solution including an isometric view of the assembled product.
 - b. Create a set of working drawings for their design solution.
 - c. Refine the design solution based upon area expert feedback.
- 6. Unit 6: Build
 - a. Identify safe practices for the use of tools and equipment.
 - b. Compile a list of materials that includes vendors and costs for all necessary materials and equipment.
 - c. Create a detailed set of instructions for assembly of a prototype that can be tested based on the information gained through research.
 - d. Build a prototype using step-by-step procedures for assembly.
- 7. Unit 7: Test
 - a. Select and describe a valid testing method to accurately evaluate the design solution's validity.
 - b. Devise a list of testing criteria to evaluate the success or failure of the prototype.
 - c. Identify, define and implement necessary modifications to the testing method based on expert feedback and ongoing research.
 - d. Create a detailed set of instructions for testing the prototype that will be valid, repeatable and reliable.
 - e. Apply the appropriate statistical analysis tools to the test results to ensure validity.
 - f. Identify, define and implement necessary modifications to the design based on test results.
 - g. Evaluate and explain the effectiveness of the design in solving the identified problem.
- 8. Unit 8: Presentation
 - a. Develop a research paper and formal presentation regarding the design solution utilizing various media formats.
 - b. Develop a cover letter, resume and portfolio to prepare for an interview for college or the workforce.

B. Assessment Methods

- 1. Skill mastery and quality of work
- 2. Engineers notebook
- 3. Portfolio
- 4. Tests and quizzes
- 5. Projects
- 6. Presentations
- 7. Research and project development
- 8. Performance tasks
- 9. Unit exams
- 10. Semester final exam/s
- 11. Presentation of Final Design Project
- 12. Culminating Project Presentation
- 13. Oral language Personal Communication Skills

III. INSTRUCTIONAL MATERIALS AND METHODOLOGIES

Course Title: Engineering Design and Development (EDD) - Project Lead the Way (PLTW)

A. Required Textbook(s)

Title: Project Lead the Way's Learning Management System

ISBN: N/A

Format: Online program

Author(s): N/A

Publisher: Project Lead the Way

Year: N/A

Additional Info: <https://www.pltw.org/>

B. Supplementary Materials

1. Robotics hardware
2. Classroom supplemental materials
3. VEX Robotics Equipment
4. CAD/Inventor Autodesk Software
5. Tools and Equipment

C. Instructional Methodologies

1. Guided Inquiry
2. Direct Instruction
3. Cooperative Learning
4. Discourse
5. Problem-based Learning
6. Visual Representations and Concrete Models
7. Field Trips/Research
8. Professional Interviews