

INTRODUCTION TO ENGINEERING DESIGN (PLTW)

Introduction to Engineering Design is a fundamental pre-engineering course where students become familiar with the engineering design process. Students work both individually and in teams to design solutions to a variety of problems using industry standard sketches and current 3D design and modeling software to represent and communicate solutions. Students apply their knowledge through hands-on projects and document their work with the use of an engineering notebook. Students progress from completing structured activities to solving open-ended projects and problems that require them to develop planning, documentation, communication, and other professional skills. Ethical issues related to professional practice and product development are also presented.

NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead the Way network and follow all training and data collection requirements.

- DOE Code: 4812
- Recommended Grade Level: 9
- Recommended Prerequisites: None
- Credits: 2 semester course, 2 semesters required, 1 credit per semester, maximum of 2 credits
- Fulfills a Directed Elective or Elective requirement for all diploma types

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

Content Standards

Domain – Design Process

Core Standard 1 Students perform the steps of the design process to develop and analyze products and systems.

Standards

- IED-1.1 Describe and apply problem solving techniques
- IED-1.2 Identify and describe the steps in the design process
- IED-1.3 Compare the design processes specific to the subject matter
- IED-1.4 Apply and adapt the design loop as a guide in creating a solution
- IED-1.5 Discuss the importance of the design process and how the process affects the outcome

Domain – Drawing Standards

Core Standard 2 Students integrate drawing standards to produce industry standard sketches and drawings.

Standards

- IED-2.1 Choose when different line types should be utilized during the drawing process
- IED-2.2 Select appropriate annotation to appropriately document features within drawings
- IED-2.3 Recognize and explain the various tolerances and their purpose
- IED-2.4 Verify sizes and shapes of objects utilizing differing measurement tools

- IED-2.5 Identify appropriate views and be able to select which should be utilized in a given situation
- IED-2.6 Develop drawings in isometric, orthographic, and perspective views
- IED-2.7 Evaluate when geometric shapes can be utilized as a part of a design
- IED-2.8 Determine how and where calculations can be made to quantify the size and locations of designs

Domain – Reverse Engineering

Core Standard 3 Students perform various analyses of systems or products with the purpose of developing improvements to those systems or products.

Standards

- IED-3.1 Perform product analyses (visual, functional, and structural) on a product
- IED-3.2 Differentiate between invention and innovation
- IED-3.3 Distinguish the relationship between reverse engineering and the next step of product/system improvement
- IED-3.4 Use information from product analyses create an innovation to a system or product

Domain – Project Management

Core Standard 4 Students manage information and data to provide better productivity through the use of engineering design process and notebook.

Standards

- IED-4.1 Justify the necessity of producing an engineering notebook
- IED-4.2 Identify the requirements for and role of intellectual property in design
- IED-4.3 Develop a working engineering notebook according to appropriate standards
- IED-4.4 Understand, develop, and implement design briefs in relation to a design problem
- IED-4.5 Understand the purpose of technical reports
- IED-4.6 Collaborate on various projects by working in design teams
- IED-4.7 Develop a Gantt chart to manage the time and progress of a project
- IED-4.8 Develop a portfolio to organize and display evidence of work

Domain – Engineering Design

Core Standard 5 Students assess the components and ethics of engineering design to understand their role in the design process.

Standards

- IED-5.1 Recognize and explain the design principles
- IED-5.2 Recognize and explain the design elements
- IED-5.3 Justify the importance of ethics in engineering design
- IED-5.4 Recognize historical and current events related to engineering design and their effects on society
- IED-5.5 Understand the effective use of engineering design equipment
- IED-5.6 Recognize and identify the role of engineering and engineered products in society
- IED-5.7 Identify the qualities of good design and their relationship to the design's user
- IED-5.8 Examine a design with respect to its quality and usability
- IED-5.9 Understand that these qualities are the result of choices made and constraints applied during the design process

Domain – Modeling

Core Standard 6 Students create designs using a variety of modeling techniques to communicate information

Standards

- IED-6.1 Communicate conceptual ideas through written and verbal formats
- IED-6.2 Select the appropriate modeling materials to complete a 3-dimensional prototype or mock-up
- IED-6.3 Evaluate a sketch and generate a model using appropriate modeling materials
- IED-6.4 Recognize and explain constraints in regard to modeling
- IED-6.5 Identify the six degrees of freedom
- IED-6.6 Differentiate between assemblies and subassemblies and their appropriate use

Domain – Aesthetics

Core Standard 7 Students demonstrate artistic fundamentals which are utilized throughout the design process to solve visual problems and communicate ideas for a product or system.

Standards

- IED-7.1 Identify the knowledge and skills gained in art experiences that transfer to the design process
- IED-7.2 Analyze the effective use of symbols, elements, principles, and media using appropriate terminology
- IED-7.3 Construct insightful, convincing interpretations of products or systems by identifying problematic features, forming theories, and evaluating alternative theories
- IED-7.4 Engage in critical reading, writing, and discourse to improve understanding of own work and that of others
- IED-7.5 Demonstrate skill in perception from real life to present convincing representation of objects or subject matter
- IED-7.6 Select subject matter, symbols, and ideas to communicate statements to the consumer
- IED-7.7 Engage in philosophical inquiry into the nature aesthetic issues independently or with others
- IED-7.8 Make informed choices about specific subject matter or concepts and defend those choices when given a range of objects or spaces
- IED-7.9 Appropriate symbols and metaphors from art and design and describe their origin, function, and value in the solutions
- IED-7.10 Demonstrate thoughtful revision and refinement of original design solutions based upon reflection, critique, practice, and research
- IED-7.11 Examine and establish criteria for judging excellence in work and revise and refine work through analysis, synthesis, peer critique, and self-evaluation, utilizing established criteria for the purpose of creating portfolio level work
- IED-7.12 Evaluate the effectiveness of elements and principles in other design solutions and use this evaluation to inform personal work
- IED-7.13 Create multiple solutions in works that demonstrate competence in producing effective relationships between elements, media, and function
- IED-7.14 Create design solutions that use specific elements, principles, and functions to solve problems and communicate ideas

- IED-7.15 Create design solutions that demonstrate skill and understanding of different media, processes and communicate ideas
- IED-7.16 Begin, define, and solve challenging visual problems, demonstrating skill and in-depth understanding of media and processes

Career and Technical Student Organizations

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as the **Technology Student Association (TSA)**.