

Principles of Engineering (PLTW)

Principles of Engineering is a course that focuses on the process of applying engineering, technological, scientific and mathematical principles in the design, production, and operation of products, structures, and systems. This is a hands-on course designed to provide students interested in engineering careers to explore experiences related to specialized fields such as civil, mechanical, and materials engineering. Students will engage in research, development, planning, design, production, and project management to simulate a career in engineering. The topics of ethics and the impacts of engineering decisions are also addressed. Classroom activities are organized to allow students to work in teams and use modern technological processes, computers, CAD software, and production systems in developing and presenting solutions to engineering problems. **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: 4814
- Recommended Grade Level: 10-11
- Required Prerequisites: Introduction to Engineering Design
- 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
- Qualifies as a quantitative reasoning course

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 – Energy and Power

Core Standard 1 Students adapt and apply energy and power concepts to develop an efficient system.

Standards

- POE-1.1 Categorize energy sources.
- POE-1.2 Analyze energy source processes.
- POE-1.3 Determine systems efficiency and energy use.
- POE-1.4 Identify and describe the possible types of power conversion.
- POE-1.5 Assess energy sources that can be combined to convert energy to useful forms.
- POE-1.6 Calculate circuit resistance, current, and voltage using Ohm's law.
- POE-1.7 Compare the advantages and disadvantages of parallel and series circuit design.
- POE-1.8 Analyze the relationships between voltage, current, and resistance
- POE-1.9 Explore ways to produce mechanical power using alternative energy.

Domain – Structural Analysis

Core Standard 2 Students interpret science and math concepts to determine the effect of stresses placed on a structure and its components.

Standards

- POE-2.1 Classify different structural elements of a system.
- POE-2.2 Analyze forces acting upon an object in a given situation.
- POE-2.3 Illustrate the moment of inertia of structural members.
- POE-2.4 Differentiate between scalar and vector
- POE-2.5 Employ appropriate scalar and vector calculation to problems.
- POE-2.6 Use equations of equilibrium to calculate unknown forces.
- POE-2.7 Use the method of joints strategy to determine forces acting on an object.

Domain – Material Properties, Testing, and Structural Analysis

Core Standard 3 Students synthesize results of tested materials and structures to determine fitness of use.

Standards

- POE-3.1 Verify non-destructive material property tests on selected common products
- POE-3.2 Demonstrate calculation of product mass properties as used for properties and testing documentation.
- POE-3.3 Identify and describe the manufacturing processes used to create common products.
- POE-3.4 Analyze material properties used to create products.

Domain – Study of Motion

Core Standard 4 Students apply and adapt the laws of motion as they apply to principles of engineering.

Standards

- POE-4.1 Demonstrate the calculation of projectile motion given parameters
- POE-4.2 Examine propulsion of an object.
- POE-4.3 Explain how gravity effects motion
- POE-4.4 Apply the laws of motion to solutions
- POE-4.5 Analyze the forces acting on a object while in motion
- POE-4.6 Describe the relationships among force, mass, and changes in motion.

Domain – Simple Machines

Core Standard 5 Students evaluate simple machines to incorporate into solving a wide range of design and application problems.

Standards

- POE-10.1 Adapt and apply six simple machines, their attributes, and components.
- POE-10.2 Calculate mechanical advantage of different mechanisms.
- POE-10.3 Design, create, and test gear, pulley, and sprocket systems.
- POE-10.4 Calculate work and power in mechanical systems.
- POE-10.5 Determine efficiency in a mechanical system.
- POE-10.6 Measure forces and distances related to mechanisms.

Domain – Statistics

Core Standard 5 Students apply and adapt basic statistics principles as it applies to project solutions.

Standards

- POE-5.1 Compare theoretical and experimental data.
- POE-5.2 Use statistics to determine theoretical outcomes.
- POE-5.3 Illustrate the use of statistics in the engineering design process.
- POE-5.4 Utilize data collection to graphically present findings.

Domain – Hydraulics and Pneumatics

Core Standard 6 Students assess hydraulic and pneumatic systems for the purpose of use as a control system component.

Standards

- POE-6.1 Distinguish between hydrodynamic and hydrostatic systems.
- POE-6.2 Calculate values in a fluid power system.
- POE-6.3 Distinguish between pressure and absolute pressure.
- POE-6.4 Distinguish between temperature and absolute temperature.
- POE-6.5 Calculate values in a pneumatic system.
- POE-6.6 Distinguish between temperature and absolute temperature.
- POE-6.7 Differentiate between the characteristics of pneumatic and hydraulic systems.
- POE-6.8 Identify and explain basic components and functions of fluid power devices.

Domain – Control Systems

Core Standard 7 Students apply concepts of computer programming, logic, and fluid power to establish an automated control system.

Standards

- POE-7.1 Create control system operating programs that utilize computer software.
- POE-7.2 Create system control programs that utilize flowchart logic.
- POE-7.3 Choose appropriate input and output devices based on the need of a technological system.
- POE-7.4 Differentiate between the characteristics of digital and analog devices.
- POE-7.5 Judge between open and closed loop systems in order to choose the most appropriate system for a given technological problem.
- POE-7.6 Describe applications of process control and automation systems.
- POE-7.7 Apply design concepts to problems in process control and automations systems

Domain – Project Management

Core Standard 8 Students manage information and data to provide better productivity and documentation.

Standards

- POE-8.1 Brainstorm and sketch possible solutions to an existing design problem.
- POE-8.2 Create a decision making matrix for design problems.
- POE-8.3 Select an approach that meets or satisfies the constraints provided in a design brief.
- POE-8.4 Create a detailed pictorial sketch and use 3D modeling software to document the best choice.
- POE-8.5 Present a workable solution to the design problem.
- POE-8.6 Document daily work and progress toward a solution in an engineering notebook.

Domain – Careers

Core Standard 9 Students assess the education, training, and certification needed for careers in engineering and engineering technology for potential career choices.

Standards

- POE-10.1 Conduct research on the current and future outlook for engineering and engineering technology careers.
- POE-10.2 Research college/technical schools for class requirements for entering engineering and engineering technology career majors.
- POE-10.3 Identify and describe different engineering disciplines.

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)**.