

*Engineers make a world of difference!*

*Students apply the engineering design process, using math, science, and engineering standards to identify and design mechanical solutions to a variety of real problems. They work both individually and in collaborative teams to develop and document design solutions using engineering notebooks and CAD modeling software.*

*Are you ready to design the future?*

Introduction to Engineering Design (IED) is a high school engineering course in the PLTW Engineering Program. In IED, students explore engineering tools and apply a common approach to the solution of engineering problems, an engineering design process. Utilizing the activity-project-problem-based (APB) teaching and learning pedagogy, students progress from completing structured activities to solving open-ended projects and problems that require them to plan, document, communicate, and develop other professional skills.

Through both individual and collaborative team activities, projects, and problems, students apply systems thinking and consider various aspects of engineering design including material selection, human-centered design, manufacturability, assemblability and sustainability. Students develop skills in technical representation and documentation especially through 3D computer modeling using a Computer Aided Design (CAD) application. As part of the design process, students produce precise 3D-printed engineering prototypes using an additive manufacturing process. Student-developed testing protocols drive decision-making and iterative design improvements.

To inform design and problem solutions addressed in IED, students apply computational methods to inform design by developing algorithms, performing statistical analyses, and developing mathematical models. Students build competency in professional engineering practices including project management, peer review, and environmental impact analysis as part of a collaborative design team. Ethical issues related to professional practice and product development are also presented.

## **Unit 1: Design and Problem Solving**

Unit 1 provides an overview of the engineering design process and helps students develop an understanding of the purpose and practice of modeling in engineering communication. Students are introduced to modeling methods and practice modeling skills important to the design of mechanical systems including technical sketching, 3D solid modeling and technical drawing using Computer-Aided Design (CAD), statistical analysis, and prototyping. Emphasis is placed on building CAD skills applied throughout the course. In addition, students learn statistical techniques to evaluate design solutions and apply statistics to inform the design of a game.

### **Design Basics**

Lesson 1.1	Design Basics
Lesson 1.2	Visualization and Solid Modeling
Lesson 1.3	CAD Fundamentals
Lesson 1.4	Product Improvement

## Unit 2: Assembly Design

Unit 2 emphasizes the design of systems of components. Students are introduced to the concept of reverse engineering and how to investigate and document the design of multi-component systems. Students learn various techniques used to connect components in a system, how systems are designed to allow desired interaction between components, and how to identify and select the materials from which products are made. They are also introduced to methods to improve the manufacturability of a product and reduce production costs. Students learn to apply two methods to create 3D assembly models in CAD and apply those techniques to design and document assemblies.

### Assembly Design

Lesson 2.1	Put it Together
Lesson 2.2	Take it Apart
Lesson 2.3	A Material World
Lesson 2.4	Fix It

## Unit 3: Thoughtful Product Design

Unit 3 introduces students to a broader interpretation of the word design to include universal principles that contribute to successful product design. Students are exposed to design principles (other than the visual design principles presented in Unit 2) that can impact the appeal, usability, safety, and sustainability of a product. Design topics that are introduced or reinforced include product life-cycle, sustainability, manufacturability, human-centred design, and systems thinking.

### Thoughtful Product Design

Lesson 3.1	Responsible Design
Lesson 3.2	More Than Parts
Lesson 3.3	Solve a Problem

## Unit 4: Making Things Move

Unit 4 focuses on familiarizing students with basic engineering knowledge related to simple mechanical and electrical systems and the use of mathematical models to represent design ideas and to inform design decisions. Students will apply their new knowledge in the design of an electromechanical solution. Students also learn advanced CAD skills to support the design, documentation, and communication of engineering solutions.

### Making Things Move

Lesson 4.1	You've Got to Move It May
Lesson 4.2	the Force Be With You
Lesson 4.3	Automating Motion
Lesson 4.4	Make it Move