# Introduction to Engineering Design and Development

Lakeside High School 2022-2023

## **ENGINEERS MAKE A WORLD OF DIFFERENCE**

Students who take the course will be introduced to...

- engineering design process
- applying math, science, and engineering standards
- identify and design solutions to a variety of real problems.
- work both individually and in collaborative teams
- develop and document design solutions using engineering notebooks and 3D modeling software.



Are you ready to design the future?

#### WHAT DOES AN ENGINEER DO? Research 101

Using your post it note, complete the following. Make sure to title your poster and put your names. USE COLOR! Grab a chromebook!

- 1. What is an engineer?
- 2. What does an engineer look like? (Draw and describe)
- 3. What does an engineer career look like?
- 4. What STEM skills do engineers use?
- 5. What kind of educational background or degree do engineers need?
- 6. What are three interesting problems that have been solved by engineers?





#### **INTRODUCTION TO COURSE**

Unit 1 Design and Problem Solving Unit 2 Assembly Design Unit 3 Thoughtful Product Design Unit 4 Making Things Move

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, using 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.



## **DESIGN AND PROBLEM SOLVING**

Course 1 is an overview of the engineering design process and helps students develop an understanding of the purpose and practice of modeling in engineering communication.

Modeling methods:

- technical sketching
- 3D solid modeling and technical drawing using Computer-Aided Design (CAD),
- statistical analysis (data)
- prototyping.





## **MAKING THINGS MOVE**

Course 4 is an overview of basic engineering knowledge related to simple mechanical and electrical systems that use mathematical models to represent design ideas and inform design decisions. You will learn advanced CAD skills to support design, documentations, and communication of engineering solutions.

#### **Concepts Learned:**

- Simple Machines Function (using CAD)
- Motion of Components
- Spring placement and Forces of Friction
- Electrical Circuits
- Electromechanical Systems



### **DESIGN CHALLENGE**

Due to the increase in gas prices, everyone is looking for alternative methods of energy or fuel to power their cars. As a society, we have become accustomed to having transportation to get from one place to another.

## Challenge: Create a device that can be attached to a car so that the battery of a car can be powered by wind energy.

Materials, circuit kit, fan motor, batteries, spaghetti noodles, glue, candy circles.

#### Criteria and constraints:

- Only materials given can be used
- 2 Batteries will be given to power circuit (one will be used at a time conserve power)
- Once car starts, it cannot be touched
- Must travel 1 meter total
- Noodles can be used to build car 30 spaghetti noodles
- 4 candies used to make tires
- Tires must rotate on their own
- Noodles must support device

#### **Creating a Design, Building a Prototype, and Testing your Design**

- 1. Create a large scale drawing of your design with all measurements and labeling of materials (cannot build until design submitted)
- 2. Create a prototype
- 3. Test your design and gather data using Vernier equipment to measure distance, time, speed, and acceleration
- 4. Re-design and Test
- 5. Write a reflection and description of your design using the engineering design process as a reference

#### Link to Resource

### ASSEMBLY DESIGN

Course 2 is an overview of how to design components within a system using reverse engineering. How are things made? What are the components of the assembly? What purpose to they serve within the design? Improving design efficiency to reduce cost is a major part of the design process. Lean six sigma is a process that engineers use to solve problems in industry.

In this course, you will 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.





#### **REVERSE ENGINEERING CHALLENGE**

The papermate company has requested your help to increase efficiency of the their toy and decrease cost by reverse engineering the pen to see what parts in the assembly need improvements.

In your groups, you will take apart the pen and construct a product assembly drawing of an exploded view of the pen. You will then draw the assembly on the paper using the exploded view and label all of the component parts with correct naming.

As a group evaluate the components that you could improve and research cost of the components to determine which is best.

Choose your best improvement and complete a write up about how this design will improve the overall function, while decreasing the cost of the product.

## **THOUGHTFUL PRODUCT DESIGN**

Course 3 is an overview of design principles that impact product design, including appeal, usability, safety, and sustainability, by talking to consumers of the product. During this course, you will learn the importance of product life-cycle, sustainability, manufacturability, human centered design, and systems thinking.

#### **Engineering Consulting**

- Meeting with clients
- Collecting Data (to drive product design)
- Solving Problems by asking questions
- Materials Science properties of component



#### **CONSULTING CHALLENGE**

Asking Questions – Who do you interview to solve problems? How do consumers play a role in the engineering design process? When do you interview consumers? Who do you interview? What questions do you ask to each person?

Challenge: Using the product you created in reverse engineering develop a list of questions and consultants you would talk to in order to increase efficiency of the pen design.

- Interview (who and what)
- Questions
- Presentation of Solution (communication of results)



### **MOVING CHALLENGE - EXTRA**

#### **CHALLENGE: Make an electromagnetic train using the materials at your desk.**

Materials: Copper wire, magnets, batteries



Study the properties of the materials and determine how the materials cause a current to flow and move the train in automation forward.

- What moves the train forward?
- Does the length of the track matter?
- Can the train loop in its movement?
- Where does the power come from?
- What forces are at play?

