

## Unit 3 Guide - Engineering is Human-Centered

### Driving Questions

In what ways does engineering intersect with people?

### Description

Students proceed through an engineering design process, define a problem, interact with stakeholders, design and construct a prototype and wrap it up with a Design-a-thon.

### Key Concepts

You(th) have the power to engineer real solutions that are relevant to their local communities. Effective engineering requires external input before, during, and after design. Effective engineering design work requires effective teamwork.

### Learning Outcomes

#### Connect with Engineering

	<b>CE.A</b>	Iterate and evolve the definition of what it means to engineer and be an engineer.
	<b>CE.B</b>	Recognize the value of engineering for all regardless of one's potential career.
	<b>CE.C</b>	Explain and apply ethical considerations when exploring an engineering problem.

#### Engineering in Society

	<b>ES.A</b>	Explore the impacts of past engineering successes and failures on society as a whole.
	<b>ES.B</b>	Recognize and investigate the world's greatest challenges and the role that engineering plays in solving these challenges (e.g., Engineering Grand Challenges, UN sustainability goals, etc.).
	<b>ES.C</b>	Integrate diverse disciplinary thinking and expertise to inform design solutions that add value to society.
	<b>ES.D</b>	Identify and analyze issues when bringing a solution to scale.

#### Engineering Professional Skills

	<b>PS.A</b>	Use various engineering communication methods.
	<b>PS.B</b>	Collaborate effectively in a team.
	<b>PS.C</b>	Develop, implement, and adapt a project management plan.

## Engineering Design

	<b>ED.A</b>	Identify and describe a problem that can be solved with a potentially new product or process.
	<b>ED.B</b>	Identify appropriate stakeholders and content experts and evaluate their input.
	<b>ED.C</b>	Plan and conduct research by gathering relevant and credible data, facts, and information.
	<b>ED.D</b>	Articulate appropriate STEM practices and principles in the design
	<b>ED.E</b>	Evaluate solution alternatives and select a final design by considering assumptions, tradeoffs, criteria, and constraints.
	<b>ED.F</b>	Create a prototype.
	<b>ED.G</b>	Create and implement a testing plan to evaluate the performance of design solutions.
	<b>ED.H</b>	Apply iteration to improve engineering designs.
	<b>ED.I</b>	Articulate and reflect on how an engineering design process could be applied to solving a problem.

### Misconceptions

We can define a problem and create effective solutions without talking to the stakeholders.

Looking at what others are doing is “cheating”.

Once we submit our design, we are done.

Teamwork means assigning each team member a task and then simply coming back together in the end to merge these individual efforts.

Working in teams makes it harder to complete tasks.

Professional skills are less important than technical skills in engineering.

### Teaching Challenges

Each school will have its own *unique local community needs*

Teachers will need to put in a lot of time and energy to *connect with community members* and generate suitable project ideas

It is challenging to identify *several different needs* within a project scope

It is challenging to create *meaningful solutions* in such a short time

The *designathon* will take a lot of time, energy, and planning

Diverse *resources* will be needed for diverse problems and solutions

## Lesson and Content Overview

Lesson Name [duration]	Lesson Description	Activity [duration]
<u>3.1 Engineering Empathy</u> [90 minutes] Video: <u>Lesson 3.1</u>	Students design a wallet for a peer as a way to build empathy.	<u>3.1.1 Designing a Wallet for a Classmate</u> [60 minutes] <u>1.4.2 Writing a Design Brief</u> [30 minutes]
<u>3.2 Establishing Team Norms</u> [145 minutes] Video: <u>Lesson 3.2-3.5</u>	Teams are formed and go through a variety of exercises to support strong team norms.	<u>1.1.2 Think-Pair-Share</u> [15 minutes] <u>3.2.1 Team Role Play</u> [30 minutes] <u>3.2.2 Knowledge Café</u> [45 minutes] <u>3.2.3 Team Charter Development</u> [30 minutes]
<u>3.3 Exploring the Needs and Problems of a Local Community Partner</u> [135 minutes]	Students revisit the PlayPump Case Study and explore the needs and problems of a community partner.	<u>3.3.1 Case Study of PlayPump's Impacts on Communities</u> [30 minutes] <u>3.3.2 Exploring a Local Community Problem</u> [65 minutes]
<u>3.4 Meeting with Stakeholders</u> [190 minutes]	Students visit the local community and ask questions of the stakeholders.	<u>3.4.1 Onsite Visit with Local Community Partner</u> [180 minutes]
<u>3.5 Problem Definition</u> [80 minutes]	Teams create rich pictures to help define their problem and then write up a problem definition design brief.	<u>3.5.1 Using Rich Pictures to Define a Problem</u> [75 minutes] <u>1.4.2 Writing a Design Brief</u> [30 minutes]

<p><u>3.6 Generating and Selecting a Design Concept</u> [170 minutes]  <u>Video: Lesson 3.6</u></p>	<p>Teams generate potential design solutions and then come to consensus about which design to pursue.</p>	<p><u>3.6.1 Function Ideation Strategy</u> [15 minutes]  <u>3.6.2 Chiming with Team Members</u> [40+ minutes]  <u>3.6.3 Design Selection with Decision Matrices</u> [60 minutes]</p>
<p><u>3.7 Engineering Drawings</u> [215 minutes]  <u>Video: Lesson 3.7</u></p>	<p>Teams flesh out the details of their designs using engineering drawings.</p>	<p><u>3.7.1 Engineering Drawings</u> [180 minutes]</p>
<p><u>3.8 Planning</u> [190 minutes]  <u>Video: Lesson 3.8-3.10</u></p>	<p>Teams set up a project management plan that supports the construction and testing of their prototypes.</p>	<p><u>3.8.1 Prototype Construction Planning</u> [30 minutes]  <u>3.8.2 Prototype Test Planning</u> [40 minutes]  <u>3.8.3 Project Management Planning</u> [60 minutes]</p>
<p><u>3.9 Prototype Creation</u> [235 minutes]</p>	<p>Teams create their first functional prototype for the purpose of testing at the Design-a-thon.</p>	<p><u>3.9.1 Prototype Creation</u> [210 minutes]</p>
<p><u>3.10 Design-a-thon</u> [185 minutes]  Video: <u>Design-a-thon Prep</u> Video: <u>Design-a-thon Event</u></p>	<p>Stakeholders test and provide feedback on teams' first prototypes followed by rapid iteration to respond to the feedback.</p>	<p><u>3.10.1 Design-a-thon</u> [180 minutes]</p>