

Unit 7 Guide - Engineering is Personal

Driving Questions

- What is engineering?
- What does it mean to engineer?
- What is my identity as an engineer?
- How is engineering valuable to me?

Description

Students examine their day-to-day lives to find problems that can be tackled by teams of 3 to 4 students. The process is student-driven, teacher-guided, and highly informed by the experiences from the previous units. This is the culminating team project of the course that incorporates all facets of the engineering design process. Unit 7 is an open-ended, creative, and empowering opportunity for students to realize that engineering can have a meaningful impact.

Key Concepts

Connect with Engineering: Students will reflect on any ethical implications of their designed solutions.

Engineering in Society: Students will reflect upon bringing their solution to scale as part of a reflection.


Engineering Professional Skills: Teams will interact with customers and stakeholders, and present their results as they proceed through the design process.

Engineering Design: Students will go through a complete design process with iterations

Learning Outcomes*






Connect With Engineering

CE.C	Explain and apply ethical considerations when exploring an engineering problem.	
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Engineering Professional Skills

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



Engineering Design

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

Misconceptions

- *Misconception:* Iteration should be dropped if there is not enough time.

More accurate concept: Iteration is the heart of the engineering design process. Testing the prototype, redesigning and retesting is a cycle that helps engineers improve their design to solve the posed problem. Please plan time for students to go through this process as it will allow them to gain an understanding of the design process.

- *Misconception:* A student's design will at some point be fully finished.

More accurate concept: We do not expect student designs to reach a fully finished stage in the time available. The design process is iterative. It involves testing, finding problems and making changes, then testing the new solution, finding new problems, making more changes and retesting. A design can go through this process many times before a design solution gets to an operational state where further revisions will not improve performance. Students may reach the stage where they have a working prototype, but are always elements that can be improved.

Teaching Challenges

- Students may have a difficult time producing suitable project ideas. Help focus students on the scope of the project. They may need feedback to set a realistic estimate of the time involved to develop the project, as well as help estimating the cost.
- Time will likely be crunched at the end of the year. Take care to adapt the lessons while still maintaining time for iteration and reflection. If Unit 7 is dropped, teachers should still ensure to do Unit 8 as it is the wrap-up for the course.
- The final portfolio for assessment of the e4usaE4USA course may be due before the end of the school year. Please help students plan ahead by giving them due dates throughout the year for each piece that will be handed in. Build in some extra time near the end of the year so that students can meet the assessment due date.
- Teachers must build in time to acquire materials between the time when students submit proposals (Lesson 7.5 and Lesson 7.9) and when they start to construct their prototypes.

Lesson and Content Overview

Lesson Name (duration)	Lesson Description	Activity
7.1.a: Uncover Problems (teacher-led) [70 minutes] (or) 7.1 b Uncover Problems (student led) [95 minutes]	Student projects for Unit 7 are identified, largely teacher-guided (7.1a) or student driven (Lesson 7.1b)	7.1.1 Problem Scoping
7.2 Team Charter [55 minutes]	Development of the Team Charter	3.2.3 Team Charter Development
7.3 Documenting Prior Solutions and Setting Solution Design requirements [195 minutes]	Solution design requirements using lessons learned in past iterations	7.3.1 Problem Specifications
7.4 -Finding the Right Design Idea [75 minutes]	Teams establish a final design idea	3.6.3 Design Selection with Decision Matrices
7.5 - Project Proposal [200 minutes]	Development of a project proposal, crucial to success of the final design	7.5.1 Preparing a Proposal

		3.7.3 Project Management Planning
7.6 - Design Drawings [215 minutes - may vary significantly]	Design drawings in 2-D and CAD	3.7.1 Engineering Drawings
7.7 - Create a Functioning Prototype and Design Tests [210 minutes - may vary significantly]	Physical prototype and test-plans	3.8.1 Prototype Construction Planning 3.9.1 Prototype Creation 2.10.1 Design Iteration 3.8.2 Prototype Test Planning
7.8 - Testing Prototypes [90 minutes]	Test of functional prototypes	7.8.1 Testing Prototypes
7.9 - Debriefing and Plan Iterations [135 minutes]	Iteration of the initial design	7.5.1 Preparing a Proposal
7.10 - Drawings of Improved Designs [75 minutes]	2-D and CAD drawings	3.7.1 Engineering Drawings
7.11 - Improved Functional Prototype [210 minutes]	Development of a refined prototype	3.8.1 Prototype Construction Planning 3.9.1 Prototype Creation 2.10.1 Design Iteration 3.8.2 Prototype Test Planning
7.12 - Evaluating Performance of Second Prototype [90 minutes]	Test and evaluation of improved prototype	7.8.1 Testing Prototypes
7.13 - Team and Design Debrief [135 minutes]	Debrief and reflection	7.13.1 External Evaluation 7.13.2 Debrief Teamwork