

## Unit 7 Guide - Engineering is Personal

**Grade level:** HS

**Choose from:** 15 lessons

**Thread concentration:** Red, Yellow, Blue, Green

### Engineering Category:

1. Relating science and/or math concept(s) to engineering
2. Engineering analysis or partial design
3. Engineering design process
4. Engineering professional skills

### Engineering Connection

What is engineering?

What does it mean to engineer?

What is my identity as an engineer?

How is engineering valuable to me?

### Description/Summary

Students examine their day-to-day lives to find problems that can be tackled by teams of 3 - 4 students. The process leading to a design solution is student-driven, teacher-guided, and highly informed by the experiences from the previous quarters. This is open ended co-creation.

### Unit Overview

Students are empowered to realize “Engineering can have a meaningful impact on me”.

Iteration is critical to engineering design and is used to improve the final outcome of a design.

### Learning Outcomes

Discover Engineering		
Iterate and evolve the definition of what it means to engineer and be an engineer.	E.A	a
Awareness of changing perspectives on one's current identities with respect to engineering through regular reflection.	E.B	a
Recognize the value of engineering for all regardless of one's potential career.	E.C	a
Explain and apply ethical considerations when exploring an engineering problem.	E.D	a
Engineering in Society		
Use systems thinking to propose and analyze the relationship between inputs, intention, and impacts of technology in society.	S.B	a
Recognize and investigate the world's greatest challenges and the role that engineering plays in solving these challenges (e.g., Engineering Grand	S.C	a

Challenges, UN sustainability goals, etc.).		
Integrate diverse disciplinary thinking and expertise to inform design solutions that add value to society.	S.D	a
Identify and analyze issues when bringing a solution to scale.	S.E	a
<b>Engineering Professional Skills</b>		
Apply strategies to collaborate effectively as a team.	P.A	a
Use various forms of communication (oral, written, visual).	P.B	a
Recognize when to use various communication tools based on audience.	P.C	a
Develop, implement, and adapt a project management plan.	P.D	a
Contribute individually to overall team efforts.	P.E	a
<b>Engineering Design</b>		
Uncover a problem that can be solved with a potentially new product or process.	D.A	a
Identify appropriate stakeholders and evaluate stakeholder input.	D.B	a
Plan and conduct research by gathering relevant and credible data, facts, and information.	D.C	a
Evaluate solution alternatives and select a final design by considering assumptions, tradeoffs, criteria, and constraints.	D.E	a
Create a prototype.	D.G	a
Create and implement a testing plan to evaluate the performance of design solutions.	D.H	a
Apply iteration to improve engineering designs.	D.I	a
Key: (a) assessed during learning progression		

### Misconceptions

Iteration should be dropped if there is not enough time.  
My design will at some point be fully finished.

### Teaching Challenges

Students may have a difficult time producing suitable project ideas.  
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.  
The final portfolio for assessment of the E4USA course may be due before the end of the school year.

## Related Lessons and Activities and Unit Schedule

Lesson Name	Lesson Description	Activity	Assessments
7.1A: Uncover problems (teacher-led) (1.5 hrs) -or- 7.1B: Uncover problems (student-driven) (1 hr)	Students explore and select problems in their everyday lives that can be pursued by small teams during the last quarter of the year. 7.1 Version B offers more student autonomy in forming teams than 7.1 Version A.	<ul style="list-style-type: none"> <li>●Explore and select personal projects</li> <li>●Form teams</li> </ul>	<ul style="list-style-type: none"> <li>●[7.1A&amp;B] Problem scoping assignment</li> <li>●[7.1B] Written team proposal</li> </ul>
7.2: Team Charter (50 min)	Students meet their teams & create new team charters	<ul style="list-style-type: none"> <li>●Discuss team norms</li> <li>●Write team charter</li> <li>●</li> </ul>	<ul style="list-style-type: none"> <li>●Team charter</li> <li>●Individual reflection on teamwork</li> </ul>
7.3: Documenting Prior Solutions and Setting Solution Design Requirements (3 hr 15 min)	Students begin the process of defining their problem.	Begin problem definition	<ul style="list-style-type: none"> <li>●Short write-up on deficiencies of existing solutions</li> </ul>
7.4: Finding the best design idea (1.25 hrs)	Teams explore a wide variety of design options and make a plan for how they will pick the best design ideas.	<ul style="list-style-type: none"> <li>●Brainstorm</li> <li>●Decide on criteria and weights</li> </ul>	<ul style="list-style-type: none"> <li>●Record of brainstorming</li> <li>●List of criteria and weights</li> </ul>
7.5: Project proposal (2.25 hrs)	Teams make final design decisions and prepare a project proposal that will be reviewed by the teacher.	<ul style="list-style-type: none"> <li>●Make final design decisions using decision matrix</li> <li>●Prepare project proposal</li> </ul>	<ul style="list-style-type: none"> <li>●Project proposals</li> </ul>
7.6: Design Drawings (3.5 hrs)	Teams flesh out the details of their designs.	<ul style="list-style-type: none"> <li>●Detailed design and sub-system definition</li> <li>●CAD and technical engineering drawings</li> </ul>	<ul style="list-style-type: none"> <li>●CAD and technical engineering drawings</li> <li>●Revised project development plan</li> </ul>

		<ul style="list-style-type: none"> <li>● Consultations with instructor</li> <li>● Update project development plan</li> </ul>	
7.7: Create a functional prototype (3.5 hrs)	Teams construct their 1st functional prototype.	<ul style="list-style-type: none"> <li>● Construct prototype</li> <li>● Update testing plan</li> </ul>	<ul style="list-style-type: none"> <li>● Prototype</li> <li>● Written testing plan</li> </ul>
7.8: Evaluating performance of first prototype (1.5 hrs)	Users test the prototype while the team collects data and feedback.	<ul style="list-style-type: none"> <li>● Testing</li> </ul>	<ul style="list-style-type: none"> <li>● Testing results</li> </ul>
7.9: Debriefing and plan iteration (1.5 hrs)	Teams debrief and make a plan for iteration.	<ul style="list-style-type: none"> <li>● Debrief testing data</li> <li>● Identify iteration focus</li> <li>● Refine the problem definition</li> <li>● Brainstorm</li> <li>● Select changes to implement</li> <li>● Justify chosen changes and predict effects</li> </ul>	<ul style="list-style-type: none"> <li>● Written iteration plan</li> </ul>
7.10: Drawings of improved design (1.25 hrs)	Teams flesh out the details of their improved designs.	<ul style="list-style-type: none"> <li>● Update detailed designs and sub-system definitions</li> <li>● Update CAD and technical engineering drawings</li> <li>● Update project development plan</li> </ul>	<ul style="list-style-type: none"> <li>● Updated CAD and technical engineering drawings</li> <li>● Revised project development plan</li> </ul>
7.11: Improved functional prototype (3.5 hrs)	Teams construct their 2nd functional prototype.	<ul style="list-style-type: none"> <li>● Construct prototype V2</li> <li>● Create testing plan V2</li> </ul>	<ul style="list-style-type: none"> <li>● Prototype V2</li> <li>● Written testing plan V2</li> </ul>
7.12: Evaluating performance of second prototype (1.5 hrs)	Users test the prototype while the team collects data and feedback.	<ul style="list-style-type: none"> <li>● Testing V2</li> </ul>	<ul style="list-style-type: none"> <li>● Testing results V2</li> </ul>

<p>7.13: Teams and design debrief (1.5 hrs)</p>	<p>Teams debrief the project, considering improvements they would make to the design, the team, and project management.</p>	<ul style="list-style-type: none"> <li>● Pair and team discussions</li> <li>● Individual reflections</li> </ul>	<ul style="list-style-type: none"> <li>● Team design brief</li> <li>● CATME peer evaluations</li> <li>● E4USA team performance rubric</li> <li>● Individual reflection on growth towards individual goals</li> </ul>
<p>7.13: Reflecting on the role of engineering in society (1.25 hrs)</p>	<p>Teams reflect on the role of engineering in society and share with the class through a gallery walk.</p>	<ul style="list-style-type: none"> <li>● Team discussions</li> <li>● Class gallery walk</li> <li>● Class debrief</li> </ul>	<ul style="list-style-type: none"> <li>● Gallery walk</li> </ul>
<p>7.14: Myself as an engineer (2 hrs)</p>	<p>Students debrief their experiences in this course, focusing on the self as an engineer.</p>	<ul style="list-style-type: none"> <li>● Think-pair-share discussions on red thread topics</li> </ul>	<ul style="list-style-type: none"> <li>● Revised and forward thinking double-sided poster of “myself as an engineer”</li> <li>● Compiled inspirational video</li> <li>● Preparatory work for share-out with the larger school community at a showcase event</li> </ul>
<p>7.15: Share out to the larger school community (outside of class)</p>	<p>All members of the school community are invited to engage with the teams and learn about their final projects.</p>	<ul style="list-style-type: none"> <li>● School showcase</li> </ul>	<ul style="list-style-type: none"> <li>● Various modalities of team share-outs</li> </ul>