Unit 3 Guide - Engineering is Human-Centered

Driving Questions
What is engineering design?
Who is involved in engineering?
Am I an engineer?
How do I collaborate to work on a team?

Description
Teams of 3-4 students will select a local problem for which they will research and design a solution. This will be an in-depth investigation into "what is the real problem" as well as stakeholder analysis. The goal is to creatively design and construct a low-cost functional prototype to be presented at an in-school designathon, at which teams will seek user input and community partners will provide critical feedback.

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

Discover Engineering	
Iterate and evolve the definition of what it means to engineer and be an engineer.	E.A
Awareness of changing perspectives on one's current identities with respect to engineering through regular reflection.	E.B
Recognize the value of engineering for all regardless of one's potential career.	E.C
Explain and apply ethical considerations when exploring an engineering problem.	E.D
Engineering in Society	
Explore the impacts of past engineering successes and failures on society as a whole.	S.A
Use systems thinking to propose and analyze the relationship between inputs, intention, and impacts of technology in society.	S.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.).	S.C
Integrate diverse disciplinary thinking and expertise to inform design solutions that add value to society.	S.D
Identify and analyze issues when bringing a solution to scale.	S.E
Engineering Professional Skills	
Apply strategies to collaborate effectively as a team.	P.A
Use various forms of communication (oral, written, visual).	P.B
Recognize when to use various communication tools based on audience.	P.C
Develop, implement, and adapt a project management plan.	P.D
Contribute individually to overall team efforts.	P.E
Engineering Design	

	Uncover a problem that can be solved with a potentially new product or process.	D.A
	Identify appropriate stakeholders and evaluate stakeholder input.	D.B
	Plan and conduct research by gathering relevant and credible data, facts, and information.	D.C
	Model physical situations using mathematical equations.	D.D
	Evaluate solution alternatives and select a final design by considering assumptions, tradeoffs, criteria, and constraints.	D.E
	Use and recognize when to use computational tools.	D.F
	Create a prototype.	D.G
	Create and implement a testing plan to evaluate the performance of design solutions.	D.H
	Apply iteration to improve engineering designs.	D.I

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.

Vocabulary

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 *SchoolHack* will take a lot of time, energy, and planning
Diverse *resources* will be needed for diverse problems and solutions

Culturally Responsive Teaching Practices
(Ethan will give a better idea of what we could include here)

Lesson and Content Overview

Lesson Name	**Lesson Description**	**Activity**	**Assessments**
3.1: With whom do we interact when we design? (1.5 hrs)	●Design for the user / user empathy ●Foster intra-team relationships	●Wallet design	●Wallet prototypes ●Design briefs
3.2: How can my team	●Establish team norms	●Discussion of good/poor team norms	●Team charters ●Individual reflections

establish solid foundations? (2 hrs)	●Develop a project management plan	●Generation of team charter	
3.3: What are the needs of the local community? (1 hr)	●Explore the needs/problems of a local community partner	●Conduct background research	
3.4: What impacts might our solutions have on the local community? (1.5 hrs)	●Use case study to explore the relationship between inputs, intention, and impacts of technology in society	●Discuss case study ●Prepare for field trip to community partner site	●Prepare observation log for field trip, including list of questions
3.5: Why meet clients on their turf? (3 hrs)	●Community field trip	●Community field trip	●Filled-out observation log
3.6: How do we define the local problem? (1 hr)	●Problem definition	●Rich Picture activity	●Rich Picture ●Design brief - Problem definition statement
3.7: How many solutions can you come up with? (1 hr)	●Concept Generation	●Sample brainstorming activities	
3.8: How do we select a solution to pursue? (1 hr)	●Design selection	●Sample concept selection (ex. Pugh Matrices)	●Design brief - Design justification
3.9: What are ways to communicate design details before constructing a prototype? (3.5 hrs)	●Design on paper	●Hand sketch ●Generate CAD parts and assemblies ●Generate engineering drawings	●Design brief - Hand sketches & CAD engineering drawings

3.10: How can we best prepare for the Designathon? (1 hr)	●Prepare for the Designathon	●Create construction plan for 1st functional prototype ●Start testing plan ●Modify project management plan	●Adapted project management plan
3.11: What goes on during construction? (3.5 hrs)	●Build 1st functional prototype	●Build 1st functional prototype	●1st Prototype ●Written test plan
3.12: How can our prototype improve? (3.5 hrs)	●Designathon	●Test and seek feedback ●Rapidly iterate ●Test and seek feedback again	●Record of testing data ●Record of design iteration ●2 presentations

Sample timeline assuming approximately 3.5 hours in class per week

Week 1

3.1: Wallet design (1-1.5 hrs)
3.2: Explore local problems, prepare for community field trip (1 hr)
3.3: Go on community field trip

Week 2

Students indicate problem preferences and individual strengths/weaknesses before class so that teacher can form teams
3.4: Team building activities (1 hr)
3.5: Case study of local problem/solution with discussion happening in teams (1 hr)
3.6: Define local problem in-depth (1.5 hrs)

Week 3

3.7: Brainstorming, research, design selection (3.5 hrs)

Week 4

3.8: Design on paper (3.5 hrs)

Week 5

3.9: Build functional prototype (and also test, iterate) (3.5 hrs)

Week 6

3.10: Plan outside user testing (1 hr)
3.11: Prepare presentations for SchoolHack (1 hr)
3.12: SchoolHack (outside of school/after school)

Notes from discussions between Cheryl and Jackelyn

- Teams keep changing in the first 2 units, students are growing as teammates, now they're on a new longer term team for Unit 3
    - Use peer evaluations, reflect on and internalize feedback, track their improvements
- Focus of project work in teams to happen inside of classroom so that we don't assume it will be easy for them to get together outside of class time, do expect that individual parts can be done outside of class
- Some thoughts on working with community partners
    - Initial field trip
    - Getting and tracking needs
    - Keeping consistency even if the people that come back for the hackathon are different than the initial people
    - Last presentation may not get feedback from community, but teacher can still use the listed needs and the feedback to assess their iteration
    - Even if the partners...