Unit 5 Guide - Engineering is Intentional

Driving Questions

- How is engineering intentional?

Description

This unit focuses on the intentionality of engineering to solve high quality targets - or problems that really need to be solved. Students are encouraged to consider 'wild ideas' as they come up with possible solutions for these high-quality targets. Students also participate in an ethics case study and consider the continued role of ethics both in the problems they choose to solve and their solutions. Students will expand their use of the Engineering Design Process Portfolio, completing more of the elements and improving their documentation of their design work

Key Concepts

Connect with Engineering A case study on engineering ethics is included in this unit. Students will assess not only the ethics of a particular engineering solution, but the ethics of trying to solve the problem in the first place. These ethical considerations will carry forward as they select a new problem to solve.

Engineering in Society In Units 5 and 6, students will select and solve a problem to answer the prompt of changing the world for $1000 or less. These problems will draw upon the Engineering Grand Challenges or similar societal challenges.

Engineering Professional Skills Students will again review their teamwork skills at the end of the unit. Students will also communicate orally and verbally in the unit. They will reach out to potential mentors and ask for their help. They will also create a project pitch for their two best design solutions and receive feedback.

Engineering Design Students will identify and justify a problem that needs to be solved - a high quality target. They will conduct research on related problems and assess strengths and weaknesses of those prior solutions in solving the current problem. A detailed list of measurable criteria and constraints will be created. Students will then brainstorm solutions and create two hybrid (parts from two different team members) solutions. A project pitch will be created and delivered to evaluators for feedback.

Learning Outcomes*

Connect With Engineering

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

Engineering in Society

ES.A	Explore the impacts of past engineering successes and failures on society as a whole.	
ES.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.).	
ES.C	Integrate diverse disciplinary thinking and expertise to inform design solutions that add value to society.	

Engineering Professional Skills

PS.A	Apply strategies to collaborate effectively as a team.	
PS.B	Use various forms of communication (oral, written, visual).	

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.E	Evaluate solution alternatives and select a final design by considering assumptions, tradeoffs, criteria, and constraints.	

Misconceptions

- *Misconception*: Innovation is defined by anything labeled as new technology.

  More accurate concept: Innovations can also be applied to older technologies in the form of iteration.

LIVE

- *Misconception*: Good managers make good innovators.

  More accurate concept: Management is the reduction of a variety of ideas, innovation typically includes the introduction of a variety of ideas.

- *Misconception*: Innovation is widely accepted and desired by communities.

  More accurate concept: Communities may be resistant to change and innovation!

- *Misconception*: Engineers are not helpful during the design of the plan or idea because they only focus on feasibility. In other words, engineers should only be tasked with executing a design.

  More accurate concept: Engineers play a critical role in both the design process as well as the execution.

- *Misconception*: A group of experts is automatically an expert group.

  More accurate concept: An expert group usually has a common objective or problem to solve. A group of experts without a unifying goal may not function at the same level of expertise as a coordinated team.

Teaching Challenges

- Students may get stuck on their (or their groups') first idea. Encourage them to work to the next iteration and the next iteration.
- Students may want to choose a big project over one that can be done quickly. Encourage students to think about the scope of the project while keeping in mind the time necessary for completion.
- A teacher may unintentionally focus on previous student competencies over student growth. Help students design projects that require skill acquisition and practice, not only execution.
- Students may plan ambitious projects that are likely to fail due to student capability and complexity of the project. Try to redirect and refocus their ideas to obtainable goals that can succeed.
- Student diversity in projects requires responsiveness and a "lead-learner" attitude.
- Please keep in mind that all student projects will involve creating a physical product, a prototype, as part of the design process.
- Students and teachers may not feel fluent or familiar with MyDesign Scoring Rubric, among other physical and digital tools.

Lesson and Content Overview

Lesson Name (duration)	Lesson Description	Activity
5.1 Engineering as Invention and Innovation [135 min] **Video: Lesson 5.1**	Review past innovations and inventions and how they came to be.	5.1.1 Find and Research Important Innovations
5.2 Ethics by Design [45-60 min] **Video: Lesson 5.2**	Review a Case Study and draw out the role of ethics in engineering.	5.2.1 Ethics Case Study 1.1.2 Think-Pair-Share
5.3 Identifying A Problem [81-89 min] **Video: Lesson 5.3-5.4**	Students create an elevator pitch about why their problem should be solved.	5.3.1 Identify a Challenge 3.2.3 Team Charter Development
5.4 High Quality Targets [120-130 min]	After exploring what a high-quality target is and the value of having wild ideas, students identify and justify the Grand Challenges-based problem their team will solve.	5.4.1 Introducing High-Quality Targets 5.4.2 Guess the Wild Idea 5.4.3 Selecting, Presenting, and Justifying a Problem
5.5 Knowing Who Knows and Asking for Help! [65-80 min] **Video: Lesson 5.5**	Identify potential project mentors, plan how to approach them, and do so. Integrate knowledge gained into EDP portfolio.	5.5.1 Mentoring Mapping and Asking for Help
5.6 Prior Solutions and Solution Design Requirements [165 min] **Video: Lesson 5.6**	Review prior solutions and analyze for strengths and weaknesses related to the current problem. Develop measurable criteria and constraints.	5.6.1 Prior Solutions and Solution Design Requirements
5.7 Selecting and Pitching Your Idea [255 min + 15 min per team]	Move from structured brainstorm to generating two hybrid solutions per team. Create a project pitch	5.7.1 Structured Brainstorming

Video: Lesson 5.7	for each team. Share those project pitches with evaluators and receive feedback.	5.7.2 Designing Hybrid Solutions 5.7.3 Presentation to the Evaluators