Unit 2 Guide - Engineering is Creative

Driving Questions

Who do engineers design for and how does the product impact the user?
How do engineers go from problem to product?
How do we know our design works?

Description

The students will engage in a guided whole-class engineering challenge tethered to a teacher-provided global issue related to a local problem. The students will design, construct, test and evaluate their product(s) to address a need e.g. water filtration.

Key Concepts

(Design) Design is a process that requires us to test how well we meet our initial goals which are often established through stakeholder inputs.
(Engineering Discipline) The role of civil engineers in providing clean drinking water will be highlighted.
(Teamwork) Students will be introduced to teamwork.
(Ethics and Society) Engineering design can impact society and choices/decisions may not occur in isolation.

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.
	ES.D	Identify and analyze issues when bringing a solution to scale.

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, tradeoffs, 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

Engineers work in isolation, without input from others; stakeholders, team members.
Engineers focus on the technology and do not need to learn how to write.

Teaching Challenges

Using typical engineering tools (Technical Drawing and Computer Aided Design)
Teaching teaming and how to support multiple groups during the design process
Teaching Engineering
Failing is still learning / Failure is necessary

Lesson and Content Overview

Note: this unit will be a whole-class project with some parts being done in small 3-4 person teams and the rest done in the whole-class “team”

Lesson Name [duration]	Lesson Description	Activity [duration]
2.1 Introduction to Teaming [85 mins] Video: Lesson 2.1	Introduce teamwork and characteristics of a high functioning team.	Activity 2.1.1 Rain Shelter Design [75 mins]
2.2 Community Based Problems [90-95 mins] Video: Lesson 2.2	Investigation of access to clean water, both as an Engineering Grand Challenge and for some areas, a local community issue.	Activity 2.2.1 Potable Water in the Community [60 mins]
2.3 Introduction to the Engineering Design Process [45 mins] Video: Lesson 2.3-2.6	Recognizing multiple models exist for the engineering design process (EDP), the class creates their process of engineering design activities.	Activity 2.3.1 Engineering an Engineering Design Process [45 mins]
2.4 Problem Definition [135 mins]	Students are presented with an access to clean water problem and asked to design a solution. Students research the science behind water quality and safety as well as filtration.	Activity 2.4.1 Personal Potable Water Device Problem [95 mins] Activity 2.4.2 Research the Science [35 mins]
2.5 Ideation [55 mins]	Innovative ideas and solutions are often created through brainstorming. Brainstorming requires team synergy to build upon one another and to promote an environment that allows for the sharing of thoughts and ideas.	Activity 2.5.1 Brainstorming [50 mins]
2.6 Design Selection [130 mins]	Class decides on a solution design using specified criteria and a justified scoring system.	Activity 2.6.1 Mathematical Modeling [50 mins] Activity 2.6.2 Design Selection [75 mins]
2.7 Sketching a Design [135-245 mins] Video: Lesson 2.7	Learn to sketch. Optionally, learn to do computer aided drawings.	Activity 2.7.1 Sketching a Design [130-240 mins]
2.8 Prototype Creation [100-105 mins] Video: Lesson 2.8-2.10	Prototype 1.0; Teams (3 or 4 members) will build their own prototypes.	Activity 2.8.1 Prototype Creation [95-100 mins]

2.9 Prototype Testing [100 mins]	Does this “work”? An important part of the design process is to test whether the design works as expected.	Activity 2.9.1 Prototype Testing [90 mins]
2.10 Design Iteration [85 mins]	Testing data improves design iteration.	Activity 2.10.1 Design Iteration [80-85 mins]
2.11 Design Communication Through Posters [130 mins] Video: Lesson 2.11-2.12	Share results of the design process with classmates. Discuss design process, effectiveness of design, team effectiveness.	Activity 2.11.1 Gallery Walk [125 mins]
2.12 Product and Team Evaluation [80 mins]	Discuss the processes, ethical implications, and performance of the solution and the teamwork.	Activity 2.12.1 Product and Team Evaluation [75 mins]
2.13 Introduction to the MyDesign Scoring Guide [95 mins]	Introduce the MyDesign Scoring Guide.	Activity 2.13.1 Introduction to the MyDesign Scoring Guide [90 mins]