Driving Question:
How can we use community feedback to optimize our design?

Overview
In this lesson, student will incorporate feedback from community members to improve their designs before they prototype it. Engineering design solutions for sustainable communities relies on iterative decision-making that includes problems and perspectives of community stakeholders.

This iterative process changes as new social and technological dimensions are (re)defined when collecting ethnographic data and during the analysis process. In this lesson, student will incorporate feedback from community members to improve their designs before they prototype it.

Lesson Standards

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<th>MS-EES3-3:</th>
<th>MS-ETS1-4:</th>
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<tr>
<td>Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment</td>
<td>Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design is achieved</td>
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<td>MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem</td>
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Objective
Students will be able to optimize both the social and technical aspects of their design by incorporating more community feedback.

I Can Statement
I can optimize my design using community feedback.

Equipment
- Devices to record interview such as IPads, laptops or cell phones
Background for Teachers

Optimize engineering designs: Multiple solutions to an engineering design problem are always possible because there is more than one way to meet the criteria and satisfy the constraints. But the aim of engineering is not simply to design a solution to a problem but to design the best solution. Determining what constitutes “best,” however, requires value judgments, given that one person’s view of the optimal solution may differ from another’s. Optimization often requires making trade-offs among competing criteria.

For example, as one criterion (such as lighter weight) is enhanced, another (such as unit cost) might be sacrificed (i.e., cost may be increased due to the higher cost of lightweight materials). In effect, one criterion is devalued or traded off for another that is deemed more important. When multiple possible design options are under consideration, with each optimized for different criteria, engineers may use a trade-off matrix to compare the overall advantages and disadvantages of the different proposed solutions. (NGSS)

Key Terms

Design Optimization → Involves making trade-offs among competing criteria to meet your desired needs (technical and social).

Trade-offs → One important aspect of what engineers do every day is to analyze and improve efficiency. By making changes to technology and human processes, engineers are always trying to think of new ways to save us time, energy, materials and costs. Engineers also look for ways to save people time in their daily lives by making "trade-offs." A trade-off occurs when we sacrifice one thing to gain something else that we value more. Trade-off decisions are made for social, environmental and sometimes economic benefits.

Students will change their designs based on feedback. This is important to help students create designs that work.

Emphasize that the designs do not have to be beautiful, but they do need to be detailed.

This means that they should include any or all the changes they think are necessary in the same sketch up.
Lesson Sequence

I. Create interview protocol

A. Point to the engineering for sustainable community principles and the engineering design cycle. Ask: “At this point, what should we do before we build our design?”

*Students should get to the point where they talk about getting community feedback on the design is important.*

- Ask: “Who should we get feedback from to optimize our design? Brainstorm a list with your students. *Examples could include classmates, teachers, staff members, parents, engineers and so forth.*
- Tell your students that you have arranged for them to be able to interview some of those community members, but first they need to write questions to ask.

TIPS

- Conducting interviews provides opportunities for students to be recognized by a wide range of others.
- Plan ahead for this, and invite people to join our class virtually if they cannot come in person.

B. Review the difference between technical and social aspects.

You can ask them to share examples of each. *For example: “Do you think the woot wall’s circuit will allow it to light up?” is a technical specification question and “Who would use this engineering design?” is a social specification question.* Or you can share example of types of questions that you would want to ask in interview and have students stand up for social or sit down for technical specifications or simply say out loud technical or social.

Then have students share what a technical specification is in their own words and what a social specification is in their own words.

C. Have your students write 4 questions that they would like to ask their community members,

- Two questions must be social aspect questions:
- Two questions must be technical aspect questions.

TIP

- Bringing together technical and social aspects provides different opportunities for students to connect with the project and to show different forms of expertise.
D. Have students write down who will ask each question. This will support all youth in have a role in the interview, and will help them to get started in the interview...

II. Interview

A. Interview Model: Model how to have an interview using the Woot Wall as an example. The teacher can be the student, and a student can be the person who is being interviewed.

Here is a sample woot wall interview

Social Aspect Questions:
- Do you think this design will help class morale?
- Who can use this woot wall and when/why?

Tech Aspect Questions:
- How long would you want the lights to stay on?
- Would you prefer the lights to be powered by solar panels or a hand crank generator?

B. Have students interview two different community members plus at least one classmate. Each interview should take about five minutes.

The community members can be a selection of the people your students’ previously brainstormed. If you are pressed for time and access to community members students could interview students from another group in your classroom, or family and friends at home as homework. Students should bring their sketches to the interview and explain how they work.

- Have students ask their questions. Each person in the group should ask one question.
- At the end of each interview, students should stop and take 2-3 minutes to write down everything they have learned under each question.

III. Optimize design

A. Incorporating interview feedback: Ask students to review their interview data in groups. Ask them to identify what feedback seems most useful.

B. Have them add these ideas to their sketch up design using different colors and making sure to label these changes.

C. Have them check-off the additional steps they took on their sketch up checklist

- Sketching and labeling their designs in groups on the large poster papers. Make sure to point out the different labels including the energy source, complete circuit and direction of electricity flow.
- Make sure that students put the dimensions on the sketch so that they are clear about the size of their design and related material needs.
- Complete the technical and social specification sheet.
- Have students complete steps #1-7 on their sketch up checklist, which they should attach to their sketch up. They will complete the other steps in lesson 7.
IV. Balancing trade-offs statement

A. Peer review: Have each group present their sketch up to the class, highlighting the following:

- What problem does your design address?
- How does your design work?
- What changes did you make based on community feedback? Why?
- What technical changes did you make? Why?
- What is one potential problem you are worried about in getting the design to work properly?

B. We suggest that each group have about 3 minutes to address these 3 questions + 2 minutes for class feedback (5 minutes per group).

C. As groups are presenting, the teacher can support students in making their designs as practical as possible
Name: ______________________________________

Group Name: __________________________________

1. Name of Engineering Design:

2. Problem it is supposed to solve:

Interview questions

3. Technical aspects questions

A. Who will ask this question? _______________________

B. Who will ask this question? _______________________

4. Social aspects questions

A. Who will ask this question? _______________________

B. Who will ask this question? _______________________

Notes: Write what you learned from the interviews:
Nombre: ____________________________________________

Nombre del grupo: __________________________________

1. Título del diseño de ingeniería:

2. Problema que se suponía que solucionará:

Preguntas de la entrevista

3. Preguntas sobre los aspectos técnicos

   A. ¿Quién hará esta pregunta? ______________________

   B. ¿Quién hará esta pregunta? ______________________

4. Preguntas sobre aspectos sociales

   A. ¿Quién hará esta pregunta? ______________________

   B. ¿Quién hará esta pregunta? ______________________

Anotaciones: Escribe lo que aprendiste de estas entrevistas.