Driving Question:
What important community problems can I solve using engineering for sustainable communities?

Overview
In this lesson students are introduced to the design challenge of making their classroom a sustainable place. After initially discussing what it means to make their classroom sustainable, students begin to gather data from school community members on the problems they feel are important. They do this through a survey that they give to both peers and adults connected to their school community.

Lesson Standards

<table>
<thead>
<tr>
<th>MS-ETS1-1</th>
<th>MS-ETS1-2</th>
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<tbody>
<tr>
<td>Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.</td>
<td>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 define a problem that matters to their school community that they can solve within the constraints of the design challenge.

I Can Statement
I can define a problem that matters to my community that I can solve through engineering.

Equipment
- IPads or Computers for administering survey
Introducing Design Challenge
Problems that matter to my community

Lesson 05
2 Class Periods

Background for Teachers
In this lesson, students will understand what kind of information they need to define a local community problem. Then they will work together to administer a survey that provides insight to local community challenges that can be solved with engineering. The survey will allow students to differentiate between student and adult responses. When you share the results with the students you can have the data sorted by the responses to question 1.

Key Terms
Technical aspects → a set of requirements that a product must meet, such as size, workload, number of parts, power requirements, etc.

Social aspects→ information from the community about the desired specifications of the product, such as easy to use, helpful to people, does not cost a lot, makes the community happier or healthier.

Lesson Sequence

Day 1
I. Engineering design challenge introduction
II. Administering surveys pre-discussion
III. Administering surveys

Day 2
IV. Data Analysis

I. Engineering design challenge introduction

A. Have the students discuss, “What does it mean to make our class and school community more sustainable?

B. In this discussion, talk about both technical aspects (e.g. using green energy and can it be a long term solution, remember lesson 3) and social aspects (e.g. making community happier and healthier). They also may include reasons why this is important.
C. Record class ideas because you will return to them in part 2

D. Introduce the design challenge: Explain that the goal is now to make their class and/or school community sustainable. Remind students that they can come up with designs that:
   - Innovate something that already exists in the classrooms
   - Create something new that contributes positively to the classroom

E. Look at the example of the Woot Wall on the slideshow

F. The engineering design must meet the following criteria:
   - Renewable energy source
   - Make something light up
   - Use materials that are readily available and reusable at school

G. Discuss each of the criteria
   - **Use a renewable source of energy**
     - Ask students to review what renewable energy sources that the class has: hand cranks, piezoelectric pads and solar panels
   - **Make something light up**
   - **Use materials that are readily available at school**
     - Brainstorm what that means for your class’s context
     - If a student asks if they can bring materials from home, either decide for yourself or open it to the class as a discussion
   - **Use the engineering for sustainable communities’ principles in the design**
     - Uses community members’ ideas in engineering
     - Helps the community solve their problems through engineering
     - Care about the environment
     - Designs solutions for now and the future

II. Administering Surveys Pre-discussion

A. Point to the engineering for sustainable communities principles and the engineering design cycle, and remind students that getting community perspectives on their problem is really important.

B. Ask them who they should ask for help in defining problems and why.

C. Explain that they are going to use a survey to share with their school community.

D. Project the survey questions provided for students to read. Discuss each of the questions and what answer choices they would provide in their survey for the problem categories they identified. The survey link is in the slide show and on qr code sheets.
III. Administering Survey

A. Divide the class into groups that will be working on their design together.

B. Ask for 3 volunteers to model survey administration (question, asker, respondent, recorder).

C. Have students practice in small groups as they complete the survey themselves. Make sure to assign a talker and recorder. Group members can trade-off on who does what. If you have access to enough iPads and WiFi, have students simply use the Survey Monkey URL. If you do need to print the survey, you will need to stop the lesson here and continue later once the surveys are printed. If not, print off the surveys, and have students record the answers using a pen or pencil.

TIP

- It is a great opportunity for students to administer the survey in person. By doing this, they are able to get recognized for their expertise, explain their work, and receive verbal feedback in addition to electronic responses.

D. Have students give the survey to community members.

- You can do this by pre-arranging with the office, cafeteria staff and other teachers for students to visit their spaces and give the survey.
- You can have community members come to your classroom.
- You can have your whole class go to another class.
- You can email your survey out for your students.
- You can utilize a combination of these options. Try to get at least 20 responses from three different type of stakeholders.

TIP

- Be creative in other ways to get community members to fill out the survey: Email or text a link to the survey to family members! If you have kids after school, have a couple of volunteers to administer the survey to parents as they pick up.
IV. Data Analysis

Note: Prior to this part of the lesson, print data summaries from Survey Monkey, filtered by stakeholder (e.g., kid, adult, community.)

Reviewing data as a class

A. Project the graphs and collated open ended response for one stakeholder group (e.g., adults).

B. Have the class review the graphs and results.
   - Which problems received votes?
   - What were some of the reasons that people gave for why these were problems?

C. Have students discuss these reasons and problems, and decide which problems and reasons are most compelling and why. Have them record their top idea on the “Community Survey Analysis”.

D. Then ask students to look at question #4 (ideas for solutions). Have them discuss which ideas give them inspiration.

Reviewing data in groups and jigsaw

E. Assign groups to their engineering design groups. These groups should have three students ideally.

F. Have students complete the data analysis sheet together

G. Discuss as a class the problems that mattered most to the community, what problems the groups want to address and initial brainstormed ideas for solutions.

This sharing positions each student as an expert.
### 1. Kids Results

<table>
<thead>
<tr>
<th>What are the top 3 problems kids identified?</th>
<th>What percentage of kids cared about this problem?</th>
<th>Why do you think this is a problem?</th>
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### 2. Adult Results

<table>
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<th>What are the top 3 problems adults identified?</th>
<th>What percentage of adults cared about this problem?</th>
<th>Why do you think this is a problem?</th>
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Name: ____________________________________________
3. **Using the data above**, what problem do you choose to fix?

_________________________________________________________________________________________

4. Why do you care about this problem?

_________________________________________________________________________________________

_________________________________________________________________________________________

5. List 3 ideas for fixing the problem that use circuits, LED lights and a green energy source.

(Feel free to use the ideas that your class has brainstormed earlier. Try glancing the survey responses for ideas, too).

Feel free to write or draw and label your answers.
Introducing Design Challenge
Problems that matter to my community
Lesson 05

Lesson 5 Objective: Students will define a problem that matters to their school community that they can solve within the constraints of the design challenge.

Community Survey Analysis Rubric

<table>
<thead>
<tr>
<th>I-Engineering Big Ideas</th>
<th>Criteria</th>
<th>Is this present?</th>
<th>Feedback</th>
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<tbody>
<tr>
<td>Uses community members’ ideas in engineering</td>
<td>Determined problems that mattered to their community most by using evidence.</td>
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<tr>
<td>Defined a problem that could be addressed with an I-Engineering project.</td>
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<td>Defined a problem that reflected community and personal concerns.</td>
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<tr>
<td>Analyzed community survey results to determine problems that mattered to their community most.</td>
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Name: ____________________________________________
### 1. Resultados de los niños

<table>
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<th>¿Cuáles son los tres problemas principales que identificaron los niños?</th>
<th>¿Cuál es el porcentaje de niños preocupados por este problema?</th>
<th>¿Por qué crees que esto es un problema?</th>
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</table>
3. **Usando los datos de arriba, ¿cuál problema solucionarías?**

4. ¿Por qué te importa este problema?

5. Enumera tres ideas para solucionar este problema utilizando circuitos, luces LED y una fuente de energía verde.

(Siéntete libre de usar las ideas que se desarrollaron en clase. También puedes echar un vistazo a las respuestas del cuestionario para tomar ideas.)
**Objetivo de la lección 5:** Definir un problema que le importa a su comunidad escolar que se puede solucionar dentro de las limitaciones de un reto de diseño.

### Rúbrica de análisis de los resultados del cuestionario

<table>
<thead>
<tr>
<th>I-Grandes ideas de ingeniería</th>
<th>Criterios</th>
<th>¿Esto se encuentra?</th>
<th>Comentarios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No hay evidencia</td>
<td>Hay evidencia</td>
</tr>
</tbody>
</table>

#### Principios de ingeniería para una comunidad sostenible

- **Usa las ideas de ingeniería de los miembros de la comunidad.**
  - Determina los problemas que más le importan a la comunidad usando evidencia.

#### Ciencia y prácticas de ingeniería

- **Definir problemas**
  - Define un problema que se puede atender con un Proyecto de ingeniería.
  - Define un problema que refleja preocupaciones personales y comunitarias.

- **Obtener, evaluar y comunicar información**
  - Analiza los resultados del cuestionario a la comunidad para determinar los problemas que más le importan a la comunidad.