LESSON

2.4 Problem Definition

Quick Look

Thread Concentrat... Green, Blue
Grade Level: 9 (9-12)
Time Required: 140 minutes
Lesson Dependency: None

Our design challenge: build an improvised wind turbine Image credit:

Purpose/Summary

Students define the problem in designing an improvised wind turbine. To introduce this challenge, students consider design criteria, specifications, and constraints as a whole class. In small groups, they research the problem and evaluate their design based on qualitative and quantitative criteria they discovered during their research.

Engineering Connection

Defining the problem in a design challenge is a crucial part of an engineer's thought process. Considering design criteria, specifications, constraints, and the ability to scale

the design all come into play when engineers define a problem.

Educational Standards

> International Technology and Engineering Educators Association - Technology

Learning Outcomes

Engineering Professional Skills

PS.B	Collaborate effectively in a team.	

1. SWBAT describe the behaviors of individuals who collaborate effectively in a team.

7. SWBAT describe team habits that support equitable teamwork.

8. SWBAT describe effective communication within the team.

9. SWBAT describe team habits that support having a positive outlook and resilience.

Engineering Design

ED.A	Identify and describe a problem that can be solved with a potentially new product or process.	

2. SWBAT identify and prioritize relevant qualitative and quantitative design requirements, criteria and constraints for a design challenge.

3. SWBAT generate objective and measurable design requirements.

ED.C	Plan and conduct research by gathering relevant and credible data, facts, and information.	

1. SWBAT document and analyze past and current attempts to solve the problem.

ED.D	Articulate appropriate STEM practices and principles in the design.	

1. SWBAT articulate STEM content, practices and principles for their design and functional claims.

Worksheets and Attachments

Lesson 2.4 Problem Definition Slide Deck
e4usa Team Performance Rubric
Activity 2.4.2 Wind Turbine Research Student Handout

Visit [www.teachengineering.org/lessons/view/e4usa-unit2b-wind-lesson4-problem-definition] to print or download.

Introduction/Motivation

Engineers follow a design process when solving a problem. A crucial part of this process is to define the problem. This lesson and activity combo focuses on clearly defining the problem in a design challenge, while considering design criteria, specifications, and constraints as a whole class.

Lesson Background and Concepts for Teachers

Materials and Cost

- **Materials**
  - computers with internet access for research purposes
  - sticky notes (if using them for voting)
- **Cost**
  - $5 for sticky notes (if using them for voting)

Before Class

- Ensure that students have access to a computer (desktop or laptop)
- Prepare a way to vote for parameters that will be addressed (such as with physical or electronic sticky notes)
- Decide how you will have students complete the e4usa Team Performance Rubric (you may wish to create an electronic form, such as a Google Form, so that the rubric can be completed electronically)

Activities and Planning Guide

[10 min] **Part 1: Introduction**

1. Tell students to consider Albert Einstein's quote: "If I were given one hour to save the planet, I would spend 59 minutes defining the problem and one minute resolving it." Ask students why they think he said that? What do they think this means?
2. [4 min] Watch Engineering Design Process - Problem Definition (Engineering for Us All)
3. Remind students that engineers follow a design process when solving a problem. A crucial part of this process is to define the problem. This lesson and upcoming activity focuses on clearly defining the problem in a design challenge, while considering design criteria, specifications, and constraints as a whole class.

[90 min] **Part 2: Conduct Activity 2.4.1 to give the specific wind turbine problem that students will solve and establish its parameters.**

1. To transition to this activity, remind students that they have begun to understand the engineering grand challenge about energy. Today they will take it to a more personal level by solving a specific challenge.
2. Refer to Activity 2.4.1 for the instructions for the activity.
3. Wrap up the activity by giving a more specific problem statement along with prioritized measurable criteria and constraints to students. Remind students that these items will be crucial to refer back to at multiple points in the process of designing a solution.

[35 min] **Part 3: Conduct Activity 2.4.2 to research the science behind wind turbines.**

1. To transition to this activity, tell students that engineers do not just guess and check possible solutions to a problem. They rely on science, technology and mathematics to make design choices and eventually to select appropriate tests to conduct. In this activity we will research wind turbines.
2. Refer to Activity 2.4.2 for the instructions for the activity.
3. Wrap up the activity by noting some key ways that the science they have researched should inform their design decisions.

Associated Activities

- 2.4.1 Improvised Wind Turbine Problem
- 2.4.2 Research the Science

Assessment

Lesson 2.4

Engineering Design Process Portfolio

While students are not yet making entries into their portfolios, the work done here would go in Elements A and C. Research on the science behind wind turbines would go into Element E.

Supplemental Resources

- KidWind Wind Turbine Basics for All Levels (Vernier Science Education)
- Designing the Perfect Wind Turbine (Museum of Science)
- How do Wind Turbines Work? (Lesics)
- Types of Wind Turbines: 3 Main Types with Details (Linquip)
- Windwise Education (Kidwind)
- Learn Wind (Kidwind)
- Advanced Blade Design (Kidwind)
- Advanced Kidwind Experiment Kit (Kidwind)

Remote Learning Tips

Google Docs is one tool for student groups to collaboratively define their problem.

Supporting Program

Engineering for US All (e4usa)

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