

Didactic Scenario

1. Title

Building Wind Turbines: Exploring Renewable Energy

2. Keywords

Wind Turbine, Renewable Energy, Wind Energy, Engineering, Construction, Design, Energy, Power, Experimentation, Statics, Creativity, Environment

3. Basic information

STEAM Subject: ENGINEERING

Typical interaction time with the instructional scenario in teaching hours for in-school work:
180 minutes

General description of the script:

<u>Phases</u>	<u>Stage</u>	<u>Time</u>
Introduction to Wind Energy	Preparatory Stage	30 minutes
Wind Turbine Design and Construction	Implementation Stage	90 minutes
Testing and Presentation	Evaluation Stage	60 minutes

Age group: 8-12 years old

Estimated difficulty level:

Very Easy	Easy	Moderate	Challenging	Very Challenging
		X		

Teaching resources

Materials:

- Plastic bottles. To create the frame of the wind turbine.
- Sticks (e.g. skewers or ice cream sticks): For the support and structure of the wind turbine.
- Cardboard or paper. For the design of the fins and other elements.
- Duct tape or glue. For connecting materials during construction.
- Recognizable electronic components: Such as small LEDs or batteries to indicate power output.
- Electronic scales. To measure the energy produced or the speed of rotation.
- Scissors. For cutting materials, if necessary.
- Diabolo and rulers. For drawing and measuring dimensions.
- Fan. To test the wind turbine under windy conditions.
- Notebooks and pencils. For recording ideas and plans.

School infrastructure:

- Work Surfaces. Tables or desks that allow students to work in groups and build their wind turbines.
- Good Internet Connection. If needed, to access online resources or videos related to renewable energy and wind turbines.
- Projector or Screen. To present information about wind turbines and the principles of wind energy during the introduction.
- Testing Area. A spacious area where students can test their wind turbines using a fan or other air sources without risking the equipment or other students.
- Headphones or Speakers. If the use of video or audio is required during the presentation.
- Security Materials. Materials to ensure student safety during construction and testing (eg, gloves, if required).

Additional material from external sources/online tools:

- NASA's Wind Turbine Challenge
(https://www.nasa.gov/audience/foreducators/lessons/Wind_Turbine_Challenge.html): Activities and instructions for building wind turbines, adapted for students.
- Engineering for Kids (<https://engineeringforkids.com/>): Resource of activities and programs that combine engineering and education, ideal for elementary school students.
- STEM activities for KIDS - Create a Moving Windmill Project.
<https://stemactivitiesforkids.com/create-a-moving-windmill-project/>

Differentiated instruction for students with different abilities and learning styles in the same class:

- Custom Activities. Create activities with different levels of difficulty. More advanced students can design more complex wind turbines, while beginners can focus on simple structures.
- Materials Options. Offer a variety of building materials (eg sticks, plastic bottles, tires) so that students can choose the ones that work best for them.
- Teamwork. Create groups of different ability levels so that more able students support others, encouraging mutual learning.
- Different Modes of Presentation. Encourage students to present their wind turbines in a variety of ways, including videos, written reports, or live demonstrations.
- Individual Support. Provide individualized guidance to students who need more help by offering extra material or homework guidance.
- Self-assessment. Encourage students to evaluate their own work and recognize their progress, enabling them to set goals for improvement.

Developed by: Development Center of Thessaly

4. Educational Problem

The script solves the problem of student alienation from science and engineering, as many students often find these concepts abstract and difficult to understand. Through hands-on wind turbine construction, students have the opportunity to apply theoretical knowledge to real-world situations, enhancing their understanding of renewable energy and engineering principles. In addition, the scenario promotes collaboration and active participation, encouraging students to work in groups, develop problem-solving skills, and enhance their critical thinking. In this way, it makes learning more fun and experiential, engaging students' interest in science and technology.

5. Learning Objective (-s)

1. Understanding Wind Energy Principles: Students will gain knowledge about wind energy, the operation of wind turbines and the principles of renewable energy.
2. Design and Build Skills: They will learn to design and build wind turbines using simple materials, applying their engineering knowledge.

3. Problem Solving Skills: Students will develop the ability to identify and solve challenges during construction and testing.
4. Cooperation and Teamwork: Through teamwork, they will learn to cooperate, share ideas and support each other.
5. Critical Thinking: They will strengthen their critical thinking skills by evaluating the performance of their wind turbines and analyzing the improvements that can be made.
6. Creativity: Students will be encouraged to use their imagination to design original and functional wind turbines.
7. Self-evaluation: They will learn to evaluate their own work and recognize their progress during the process.

6. Phases of the Scenario

Phase 1

Title: Introduction to Wind Energy

Indoor	Outdoor	Mixed
		X

Phase duration in minutes: 30 minutes

Detailed description of the scenario phase: In the 1st phase of the scenario, students are introduced to the basic concepts of wind energy and the operation of wind turbines. The instructor begins with a presentation explaining what wind energy is, how wind turbines convert wind energy into electricity, and what the benefits of renewable energy are to the environment. Students watch videos and pictures showing wind turbines in action and discuss their applications in the world. They then engage in observational activities, recognizing knowledge and ideas about the construction and use of wind turbines in everyday life. This phase aims to spark students' interest in renewable energy and prepare them for the process of designing and building their own wind turbines afterwards.

Activity Sheets:

Activity Sheet - Phase 1: Introduction to Wind Energy

Purpose: To understand the basic concepts of wind energy and wind turbines.

Activity 1: Identify Types of Wind Energy

Instructions: Read the descriptions below and match them with the correct type of wind energy.

1. Wind energy for electricity
2. Wind energy for pumping water

3. Wind energy for heating
4. Wind energy for mechanical applications

Descriptions:

- A) It is used to run wind turbines that generate electricity.
- B) It is used to draw water from wells.
- C) It is used to heat water or spaces.
- D) Used to drive machines or tools.

Activity 2: Design a Wind Turbine

Instructions: Draw your idea for a wind turbine. Use the fields below to design and describe your wind turbine.

- Wind Turbine Type: _____
- Design (design): _____

! [Design here]

- Reason for choosing this type: _____

Activity 3: Class Discussion

Instructions: Answer the following questions in class:

1. How do you think wind turbines can help the environment?
2. What are the advantages and disadvantages of wind energy?

Phase 2

Title: Bridge Design and Construction

Indoor	Outdoor	Mixed
X		

Phase duration in minutes: 90 minutes

In phase 2 of the scenario, "Design and Build a Wind Turbine," students work in groups to design and build their own wind turbine using simple materials. First, the teams discuss their ideas and design the wind turbine, determining the type and materials they will use, such as plastic bottles, sticks, tires and cardboard. They then proceed to build the wind turbine, applying the principles of engineering and renewable energy they have learned. Throughout the process, the instructor provides guidance and support, encouraging students to experiment with different designs and test the functionality of their wind turbine. This phase promotes creativity, teamwork and problem-solving skills, offering students the opportunity to combine theory and practice.

Activity Sheets: N/A

Phase 3

Title: Testing and Presentation

Indoor	Outdoor	Mixed
		X

Phase duration in minutes: 30 minutes

Detailed description of the scenario phase: In phase 3 of the scenario, students have the opportunity to test their wind turbines and share the results of their work with the class. First, the teams launch objects using their wind turbines, monitoring the efficiency and energy production by measuring the distance traveled by the launched objects. Each team presents their wind turbine to the class, explaining the design process, challenges they faced, and lessons learned from testing. Peers provide feedback and engage in an open discussion about the various approaches and strategies used. This phase enhances critical thinking, communication skills, and interaction among students, promoting collaboration and sharing knowledge about renewable energy.

Activity Sheets:

Activity Sheet - Phase 3: Test and Presentation

Purpose: To test our wind turbines and share the results of our work.

Activity 1: Testing the Wind Turbine

Instructions: Test your wind turbine by throwing objects. Fill in the following:

- Wind Turbine Type: _____
- Launch distance: _____ meters
- Notes from the Test:
 - It worked well: _____
 - There were problems: _____

Activity 2: Presentation of the Wind Turbine

Instructions: Prepare a short presentation about your wind turbine. Use the following questions for guidance:

1. What is the purpose of your wind turbine?

○ _____

2. What challenges did you face during the build?

○ _____

3. What did you learn from this process?

○ _____

Activity 3: Peer Feedback

Instructions: After the presentation, give feedback to your classmates. Use the following fields:

- Positive Points: _____

- Suggestions for Improvement:
-

7. Evaluation Methodology

A methodology that includes observation, presentation and feedback is proposed for scenario evaluation. The teacher can monitor student participation during the design and construction phases, using an observation board to note active participation and support among group members. In the testing phase, students will be evaluated on criteria such as bridge strength, application of engineering concepts and innovation in design. During the presentation, the challenges and solutions they found should be mentioned, with feedback from classmates and the teacher. In addition, students will complete a self-assessment sheet to judge their own participation and progress, thus enhancing their self-awareness. This approach provides a comprehensive view of learning, focusing on both the process and the end result.

8. Additional Resources for the teacher

Activity sheets and notes - <https://www.stem.org.uk/elibrary/resource/26094>