

**Subject:** Engineering

**Date:** 26:04:2024

**Grade level:** 4

**Lesson Title:** Renewable Energy Challenge: Designing Wind Turbines

**Duration:** 50 minutes

**Key Concepts:**

Form, Change, Function

**Standards:**

**-PS3-2.** Make **observations** to provide **evidence** that **energy** can be **transferred** from place to place by sound, light, heat, and electric currents.

**4-PS3-4.** Apply scientific ideas to **design**, test, and refine a device that **converts energy** from one **form** to another.

**Vocabulary:**

Energy transfer, prototype, multimeter, observations, form.

## Objective:

- Learners will work in small groups to design and build a wind turbine prototype that can generate electricity.
- Students will integrate knowledge from science, technology, engineering, and mathematics to understand the principles of wind energy and apply them in their designs.
- Students will demonstrate 21st-century skills such as **critical thinking, communication, collaboration, and creativity.**

## Materials:

- Cardboard, foam board or pieces of wood
- Craft sticks (popsicle sticks)
- Plastic straws
- Small motors or generators
- Tape
- Scissors
- Glue
- Assorted lightweight materials for blades (e.g., paper, lightweight plastic)
- Wire connectors
- Small LED bulbs or small light bulbs
- Fan or hairdryer (for testing)

### **Introduction (12 minutes):**

1. Begin the lesson by discussing with learners what renewable energy is and why it's important for the environment.
2. Introduce the concept of wind energy and explain how wind turbines work to generate clean electricity.
3. Watch a story about "[The boy who harnessed the wind](#)".
4. Show examples of different types of wind turbines and discuss their features.

### **Ask and Imagine (10 minutes):**

1. Divide learners into small groups of 3.
2. Instruct learners to research the basic principles of wind energy and how wind turbines are designed to capture and convert wind energy into electricity.
3. Provide each group with materials for constructing their wind turbines.
4. Encourage learners to use the Engineering Design Process (EDP) and keep in mind the 21st century skills we are focusing on (collaboration, critical thinking, problem solving, creativity, communication and digital literacy.)
5. Encourage learners to brainstorm ideas for their wind turbine designs, considering factors such as blade shape, size, and angle.

### **Plan and Create (18 minutes):**

1. Instruct each group to start building their wind turbine prototypes based on their design plans.
2. Encourage learners to work collaboratively, assigning roles and responsibilities within their group.
3. Remind learners to test their prototypes as they build, making adjustments as needed to improve performance.
4. Encourage creativity in the design process, allowing learners to experiment and explore with different materials and configurations.

### **Test and Improve (5 minutes):**

1. Connect the small motors or generators to the wind turbines and observe whether they can generate enough electricity to light up the LED bulbs.
2. Each group will test their prototypes using a fan or hairdryer to simulate wind.
3. Facilitate a class discussion where learners share their design process, explain the features of their wind turbines, and discuss the effectiveness of their designs.
4. If the prototype does not meet the criteria, learners will have to improve their prototypes until they meet the criteria.

### **Conclusion (5 minutes):**

1. Wrap up the lesson by summarizing key concepts related to wind energy and renewable energy.
2. Encourage learners to reflect on what they learned and how they can apply their knowledge to real-world challenges.
3. Assign a follow-up activity, such as researching other forms of renewable energy or designing improvements to their wind turbines based on how they did in the lesson.

### **Assessment:**

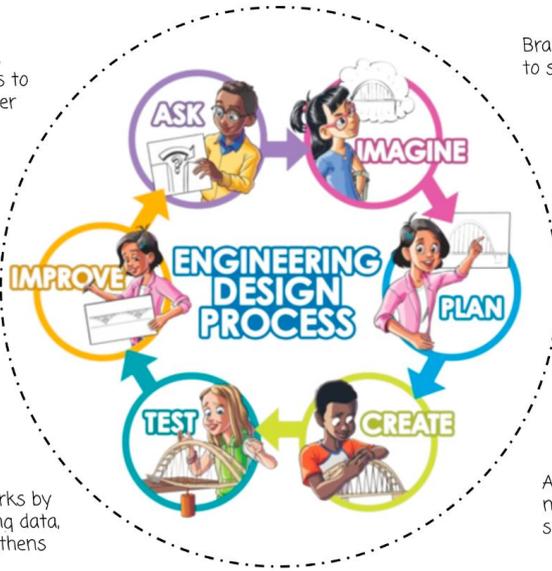
- Assess learners based on their participation in group discussions, their engagement in the design and construction process, and the effectiveness of their wind turbine prototype design in generating electricity.
- Use a rubric to evaluate students' understanding of STEM concepts, their collaboration skills, and their ability to apply engineering principles in their designs.

**Extensions:** (for learners who met the criteria)

- Have learners design different blades using 3D designing apps focusing on the sizes, blade shape and angles.
  - Tinkercad
  - SketchUp
- Learners will conduct experiments to test the effectiveness of their different blade designs and the performance of their wind turbines.
- Have learners test how much energy is being produced by the generators using multimeters.
- Invite a guest speaker, such as a renewable energy engineer or technician, to talk to the class about the real-world applications of wind energy.

# Wind Turbine with the Engineering Design Process:

Identify a problem, then ask questions to understand it better



Brainstorm ideas on how to solve the problem.

Choose one idea and plan how to create the solution.

Acquire any necessary materials and create the solution.

Make adjustments to improve the solution, then test it again.

See if the solution works by collecting and analyzing data, and evaluating strengths and weaknesses.

Critical Thinking

Problem Solving

Collaboration

Creativity

Digital Literacy

Communication



What is the purpose of designing this prototype for this unit?

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What do I want my audience to know and understand?

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**Note: Keep in mind your 2 lines of inquiry.**

An inquiry into the transformation of energy (change)  
An inquiry into how energy works (function)



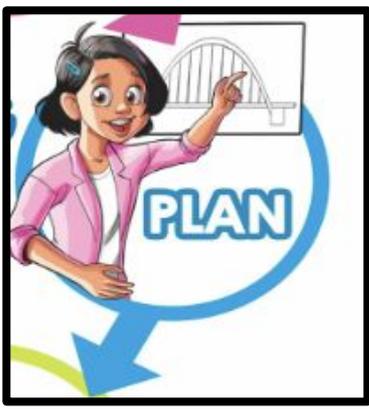
**Name** and **describe** your ideas below. **Keep in mind the research you and your team have already done.**




Consider the skills and talents you and your group members have, choose a model type that is best for your team.

Group Member Name	Skills and Talents related to the task

Develop your plan below. Draw, sketch, and label to describe your idea with clear details.

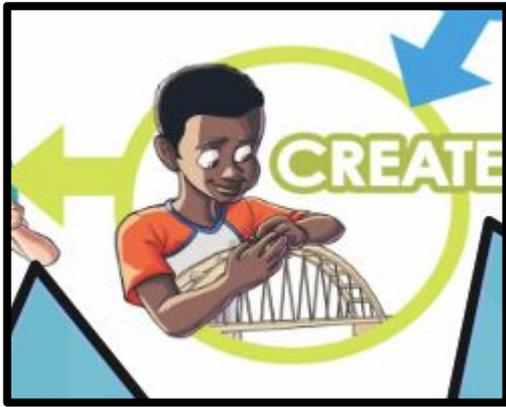


Include, extra materials needed. Identify who/where you will be able to get it.

Materials	Who to ask/Where to get	Materials	Who to ask/Where to get

Ensure each team member has a role and set of responsibilities- describe this below.

Group Member Name:	Responsibilities:

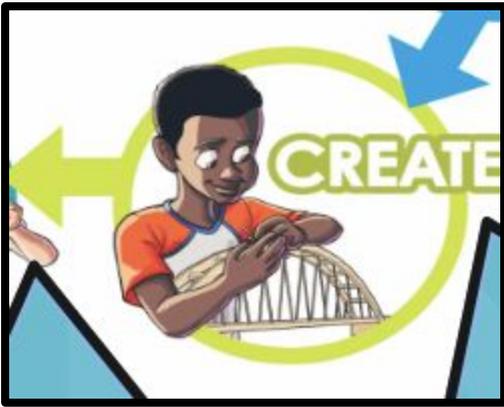


Time to create!

1. Gather all materials needed.
2. Identify a place you would like to work at.
3. Create!
4. Identify a place to keep your materials.

**Where will you keep your materials?**

**Describe/explain the experience you are creating for your audience**



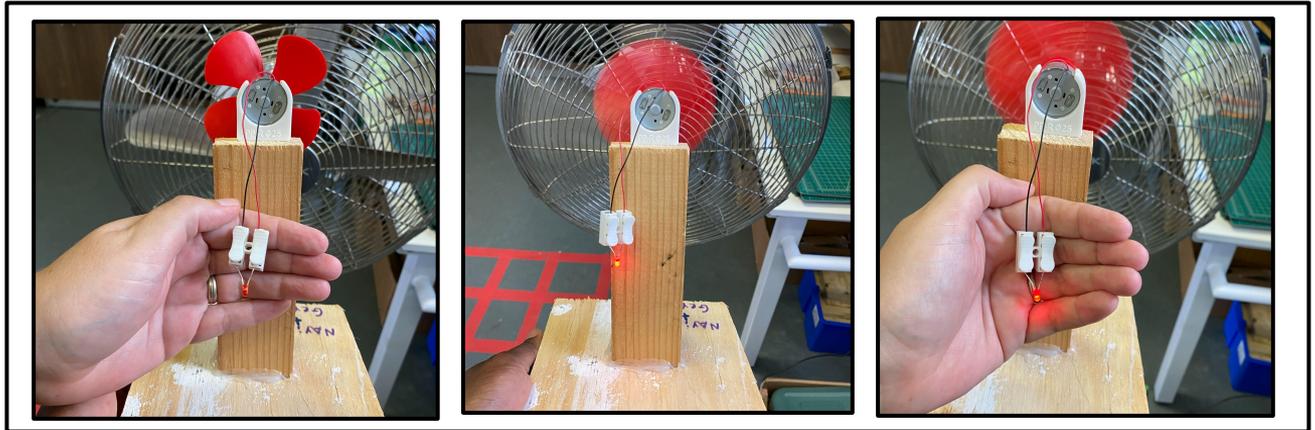
1. Document the steps you took when creating your prototype.
2. Take photos of your prototype as it develops and paste them below.





Test and ask yourself and your peers the following questions...

1. Does it work? How is it working?
2. What would you like feedback on?





1. Based on your testing and feedback, what changes do you need to make to your prototype?
2. Where might you seek help?



1. Test your prototype again.
2. Ask each other if there is anything else that needs to be addressed.
3. Continue the cycle of testing and improvement until your prototype meets the criteria.
4. Consider questions your audience may ask you. Are you able to answer those questions?