Wind Turbine Blade Design

WIND TURBINE TECHNICIAN

GRADES	LEARNING OBJECTIVE	CONCEPTS
• Grade 6 • Grade 9	Students will apply knowledge of blade design and angles to create efficient wind turbine blades. Students will measure and analyze voltage output to evaluate the performance of different blade designs.	• Renewable energy • Energy conversion • Aerodynamics • Mechanical energy • Measurement • Voltage • Power • Drag

Curriculum Connections

GRADE 6 SCIENCE

- 6–6 Construct devices that move through air and identify adaptations for controlling flight
- 6–5 Describe properties of air and the interactions of air with objects in flight
    - Describe and demonstrate instances in which air movement across a surface results in lift (Bernoulli's principle).
    - Recognize that streamlining reduces drag and predict the effects of specific design changes on the drag of a model aircraft or aircraft components.

GRADE 9 SCIENCE

- Investigate and interpret the use of devices to convert various forms of energy to electrical energy, and electrical energy to other forms of energy
    - Investigate and describe evidence of energy transfer and transformation
    - Modify the design of an electrical device, and observe and evaluate resulting changes
- Identify and estimate energy inputs and outputs for example devices and systems, and evaluate the efficiency of energy conversions
    - Identify the forms of energy inputs and outputs in a device or system
    - Apply appropriate units, measures, and devices in determining and describing quantities of energy transformed by an electrical device

Description

In this exciting lesson, students explore important ideas for becoming wind turbine technicians. Students learn about turning wind into electricity and how to make wind turbine blades work efficiently. Students work together in teams to understand how blade length, shape, and angle affect how much energy the turbines can make. Using things like cardboard and plastic, students make their own blades and put them together with sticks and glue. When they test their blades with a fan, they measure the power they make. Students then talk about their findings and think about how to improve their blade constructions.

This lesson helps students practice working in teams, thinking carefully, and using their hands to build and fix things—important skills for being a successful wind turbine technician.

TIME

- 80–90 minutes (about an hour and a half) split over two classes

MATERIALS

- Mini wind turbines
- Cardboard or lightweight plastic sheets
- One black rotor per blade set
- Scissors or craft knives
- Ruler or measuring tape
- ¼" dowels
- Hot glue guns
- Screwdrivers
- Fans
- Vernier energy sensor

Procedure

PREPARATION

- Download and open the free software on each computer that will be used at each wind testing station by using the following link: Vernier Canada Graphical Analysis
- Set up three wind testing stations around the classroom. Place fans in open areas allowing for maximum air flow. Each station will need a fan, turbine, energy sensor, screwdriver, and laptop with Vernier sensor software. Watch the following video for more information: Investigate Renewable Energy Systems with Go Direct® Energy

STEPS

Day 1

1. Introduction (10 minutes)

- Engage students in a discussion about renewable energy sources and wind power.
- Explain the concept of wind turbines and their role in converting wind energy into electrical energy.
- Discuss the importance of efficient blade design for maximizing energy production.

2. Blade design principles (10 minutes)

- Introduce students to the key factors affecting blade design, such as length, shape, and angle.
- Discuss how different blade designs impact the efficiency and performance of wind turbines.
- Show examples of different blade designs and their applications.

3. Design phase (15 minutes)

- Divide students into groups of 2 or 3.
- Provide each group with cardboard or lightweight plastic sheets, scissors, and a ruler.
- Instruct students to design and cut out wind turbine blades using their creativity and the knowledge they've gained.
- Encourage them to experiment with different blade shapes, lengths, and angles.
- Remind students to consider factors such as weight, aerodynamics, and ease of construction.

4. Construction phase (20 minutes)

- Provide students with the ¼" dowels, hot glue guns, and any other additional materials they may need.
- Instruct students to attach their wind turbine blades securely to the dowels then to the black rotors by inserting them into the holes and tightening the front screw.
- Emphasize the need for stability and balance in the blade attachment.

5. Testing phase (20 minutes)

- Set up a controlled environment using the provided fan for a wind source with all three fans and mini turbines.
- Check that all the testing stations are set up with all the required tools.
- Instruct students to use the blade protractor to set the blade angles desired on all the blades equally.
- Instruct students to position their wind turbine blades in the path of the wind source and record the voltage output.
- Encourage them to make observations and adjustments to their blade designs as needed to generate maximum electrical output.

6. Data analysis and discussion (10 minutes)

- Have students compare and analyze the voltage output data collected by different groups.
- Facilitate a class discussion on the factors that may have influenced the varying voltage outputs.
- Encourage students to reflect on the effectiveness of their designs and propose improvements.

Assessment suggestions

PRACTICAL SKILLS ASSESSMENT

- Observe students during the design and construction of their wind turbine blades, paying attention to their ability to accurately measure and cut the blade shapes and angles.
- Assess the cleanliness and precision of their blade construction, emphasizing the importance of accuracy and attention to detail.
- Evaluate students' proficiency in assembling the blades securely to the dowels.

REFLECTION AND SELF-ASSESSMENT

Ask students to reflect on their experience and assess their own work. Provide guiding questions such as the following:

- How well do you think you measured and cut the angles and blade shapes?
- Did you encounter any challenges during the design and construction process? How did you overcome them?
- How satisfied are you with the overall quality of your wind turbine blades and their appearance?
- What would you do differently if you were to repeat this project?

Web resources

- Vernier turbine assembly video: KidWind Wind Turbine Assembly
- Vernier energy sensor software video: Investigate Renewable Energy Systems with Go Direct® Energy
- Link to free software: Vernier Canada Graphical Analysis

Contributors

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