# Wind Energy Lab

Mid-Valley
STEM-CTE HUB

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# Wind Energy Lab

The Wind Energy Lab kit enables hands-on STEM learning through renewable energy exploration. Students build and test wind turbines while developing skills in engineering, physics, and data analysis. With versatile components, the kit supports projects that foster creativity, problem-solving, and critical thinking. Promotes project-based exploration of sustainable energy concepts.


## Grade Level

**4th - 8th grades**

## Group Size

**2 to 4 students per kit**

## Time Duration

**45 - 60 Minutes**

## Content of Kits

### Components

- Wind Turbine Generator with Wires
- Nacelle Body Half
- Motor Mount Pack
- 8″ Hex Shaft with Hub Quick Connect
- Wind Turbine Hub
- Power Output Board
- Tower Base Leg
- Tower Base Locking Ring
- Tower Base Hub
- Plastic Weightlifter Bucket
- Blade Pitch Protractor
- Hex Lock
- Spool
- Gear Set (8-, 16-, 32-, and 64-tooth gears)
- 20″ Tower
- 1/2″ Washer
- Dowels
- Power Output Pack
- 3″ x 12″ x 3/32″ Balsa Wood Sheet
- 3″ x 12″ Chipboard Blade Sheet
- 4′ String

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# Usage

## Getting Started

1. **Unpack and Organize Components –** Lay out all the kit components, including the motor, turbine blades, and wiring, to ensure everything is accounted for.

2. **Familiarize yourself with Instructions** – Review the instruction manual and diagrams to understand the setup process and safety precautions.

3. **Assemble the Wind Turbine** – Start by constructing the turbine by attaching the blades to the motor and ensuring they are securely fastened.

4. **Connect the Circuit** – Use the provided wires to connect the motor to the power source and other components, ensuring all connections are tight.

5. **Test the System –** Once the turbine is assembled, test the system by turning on the fan or creating wind flow to generate power and observe how the turbine spins.

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## Storage

Organize and store all components in the original packaging to ensure easy access and prevent loss.

## Troubleshooting

- **Ensure All Connections Are Secure** – Double-check that all wires, components, and connections are tightly secured to avoid power issues.
- **Test the Circuit** – Power on the system and observe the outcome to confirm the wind turbine is generating electricity as expected.
- **Check Component Placement** – If the system isn't functioning, verify that all components, such as the motor, blades, and sensor, are properly placed and connected.
- **Refer to the Online Guide** – For specific troubleshooting steps, consult the online guide or manufacturer's instructions to identify common issues and solutions.

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# Activity Guide

## Beginner

**Basic Wind Turbine**
Students will assemble a simple wind turbine and test its ability to generate energy. This activity introduces them to the fundamentals of wind power and energy conversion, allowing them to understand how mechanical energy is transformed into electrical energy. By the end of the activity, students will have a foundational understanding of how wind turbines work and how wind can be harnessed for energy production.

## Intermediate

**Blade Design Experiment**
Building on the basic wind turbine, students will experiment with different blade shapes, angles, and materials to observe how these variables affect energy production. They will modify blade characteristics and measure the output, gaining a deeper understanding of aerodynamics, efficiency, and optimization. This activity reinforces key engineering principles and provides hands-on experience with how design changes impact performance.

## Advanced

**Energy Transfer Challenge**
Use the electricity generated by their wind turbines to power small devices, such as an LED or buzzer. They will also design wind-powered mechanisms like a water pump or pulley system to apply mechanical energy to perform real work. Through experimentation and optimization, students will explore the efficiency of their turbines, considering factors such as blade shape, wind speed, and turbine positioning. This activity encourages critical thinking about real-world applications of wind energy, including environmental and economic impacts.

## Extension Activities:

**Wind Energy Efficiency Competition**
In this extension activity, students will work in teams to design the most efficient wind turbine possible, applying the concepts they've learned in previous activities. Each team will test their turbine by measuring the energy it generates under various wind conditions and experiment with different materials, blade designs, and turbine configurations. Teams will compete to see who can generate the most energy with the least amount of wind. The competition will foster collaboration, problem-solving, and creativity, as students work to optimize their designs. Afterward, they will analyze their results, discuss design choices, and reflect on the real-world applications of efficient wind energy systems in sustainable infrastructure.

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# Learning Extensions

## STEAM Connections: Electrical Ciruits - Renewable Energy

## Learning Objectives:

- Understand the basics of wind energy and energy conversion.
- Develop engineering design, problem-solving, and critical thinking skills.
- Apply scientific principles to optimize wind turbine efficiency.
- Explore the role of renewable energy in sustainability.
- Encourage teamwork and collaboration in project-based learning.

## Career Connections:

- Renewable Energy Engineer
- Mechanical Engineer
- Electrical Engineer
- Structural Engineer
- Environmental Scientist
- Data Analyst in the Energy Sector

## Essential Employability Skills:

- Critical thinking
- Problem-solving
- Creativity
- Teamwork
- Communication

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# Resources and Accessibility

## Safety Guidelines

- Ensure students follow safety protocols when assembling and testing designs.
- Supervise all building activities to ensure safe handling and use of the kit.
- Keep small parts out of reach of young children.

## Accessibility

- Ensure that workspaces are accessible to all students, including those with physical disabilities.
- Offer alternative ways for students to engage in data analysis (verbal, written, digital).
- Offer tools and modifications to accommodate various needs.

## Library Catalog

## Library Resources

## Feedback

QR to feedback survey