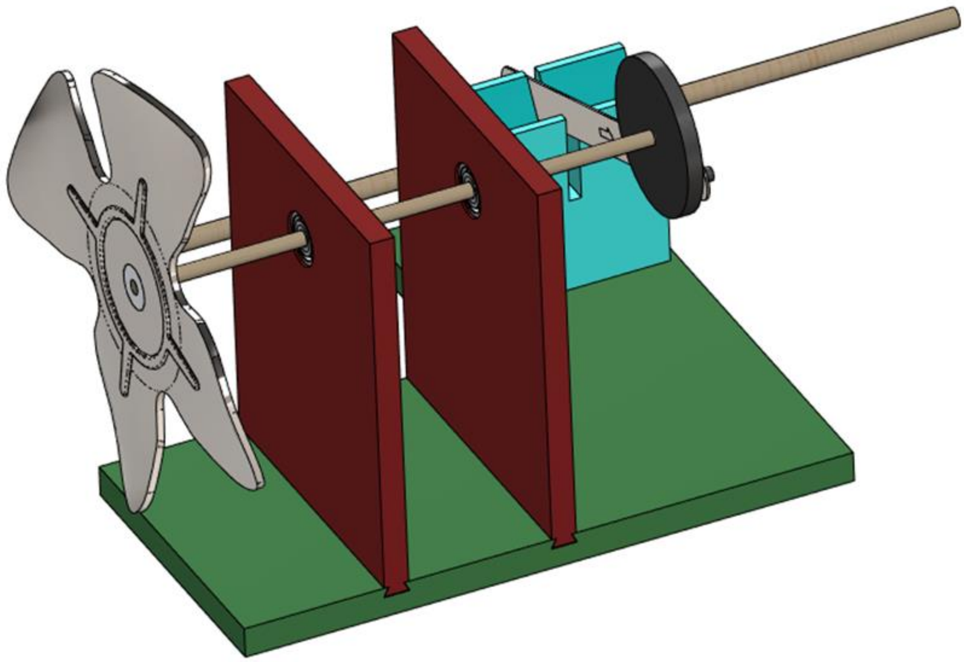
SOLIDWORKS / xDesign

DESIGN PROJECTS

TEACHER GUIDE



WIND-POWERED SAW

INTRODUCTION/GENERAL GUIDELINES

Welcome to the Design Projects Teacher Guide for a Wind-Powered Saw. This activity presents a wide range of possibilities for the instructor. The individual components are simple enough for beginners to learn the basics of designing with CAD and the result is a model that can be used to explore the aspects windmill design. This project is suitable for individuals and teams to eventually design and build their own Wind-Powered Saw.

It is recommended that you have a completed model to pass around the class during the Presentation. As an instructor, you have several resources at your disposal:

1. **Overview PDF**
   - The initial document that introduces the project providing a brief overview.
2. **Teacher Guide**
   - This document contains information that corresponds to the sections of the Presentation PowerPoint (see below). Each section discussed in this guide provides further details on how you can use the PowerPoint.
   - Also included are additional ideas you may want to use to enhance the activity in the classroom or adjust it for different skill levels.
3. **Student Guide**
   - This document is intended for students and provides basic guidelines for the activity such as deliverables, tips for creating the individual components and 3D printing guidelines.
4. **Presentation PowerPoint**
   - The PowerPoint is used to introduce the project to the class.
   - Feel free to customize any part of the presentation such as history, design concepts or any STEM related materials.
5. **Video**
   - The video is located on YouTube, and is intended to provide an overall approach to how the model could be created in CAD.
   - You may want to watch it together with the students in class.
   - LINK TO YOUTUBE VIDEO

1. **Step-by-Step Course**
   - This is where every step of the design process is demonstrated with short easy to follow procedures and video clips as well as overall videos showing the entire process.
   - LINK TO STEP-BY-STEP

BACKGROUND

The Wind Saw Project introduces students to wind-powered mechanical systems and how energy can be harnessed and transferred. Historically, wind power has been used for pumping water, grinding grain, and generating electricity. In this project, students will explore the principles of wind energy and gear-driven motion.

In this project, students will learn:

- **Mechanical Energy Transfer** – Converting wind power into rotational motion to drive a saw blade.
- **Gear Ratios & Torque** – Understanding how different cam configurations impact cutting efficiency.
- **Design for Manufacturing** – Optimizing the model for 3D printing, laser cutting, or CNC machining.

Encourage students to explore real-world wind-powered machines for inspiration, such as windmills and wind turbines.

KEY DESIGN TERMS

- **Design Intent –** Ensuring parts maintain function when dimensions are changed.
- **Additive Manufacturing –** Layer-by-layer fabrication using 3D printing.
- **Power Transmission** – The process of transferring energy from wind motion to a functional tool.
- **Gear Ratio** – The relationship between gear sizes that affects speed and torque.
- **Aerodynamics** – How airflow interacts with blade design to maximize wind capture.

COMPONENT DESIGN

Students will design components around purchased parts. Much of the design will depend on the dimensions of the purchased components. The Step By Step course suggests a 6" diameter fan blade and a 5/16" dowel. Individual projects may differ.

Encourage students to explore different cam sizes and structural designs to increase torque or saw speed and stability.

3D PRINTING

Discuss printing orientation, material usage, and support structures before students proceed with fabrication.

Consider these factors:

- Print Orientation – Parts should be optimized for strength and minimal warping.
- Tolerance Adjustments – Ensure proper fit and assembly.
- Material Conservation – Reduce waste and manage filament usage.

Alternatively, students may fabricate the puzzle pieces using laser cutting (stacked layers) or CNC machining, depending on available tools.

CLASS DISCUSSION

Encourage students to reflect on their design process with questions like:

- What challenges did you face when designing the wind capture system?
- What other methods could be used to make the custom components?
- What materials would work best for real-world applications?
- How could this concept be applied to sustainable energy solutions?
- How could this design be modified to be more efficient or use a different power source?

PROJECT TASKS (ASSESSMENT CRITERIA)

Students should complete the following:

1. Research and purchase components.
2. Model the following components in CAD:
    - Base
    - Walls
    - Cam
    - Dowel Holder
3. 3D Print small sections to test fits for the following:
    - Wall dovetail
    - Bearing hole
    - Cam holes
    - Dowel Holder dovetail
4. 3D Print full assembly
5. Assemble all the components
6. Cut a dowel

Additional Assessment Criteria

- **EFFICIENCY** – How well does the saw convert wind energy into motion?
- **STABILITY** – Does the design remain stable under wind power?
- **MANUFACTURABILITY** – Can the components be efficiently produced?
- **INNOVATION** – Are there unique design features improving functionality?

ADDITIONAL RESOURCES

- LINK TO DOCUMENTS
- LINK TO YOUTUBE VIDEO
- LINK TO STEP-BY-STEP

The following sections do not correspond to the PowerPoint, and are included here for added benefit.

EDUCATIONAL CONCEPTS

This Wind-Powered Saw design and construction project is an excellent way to integrate multiple STEM concepts. Here are some potential teaching approaches:

SCIENCE

- Explore the physics of wind energy and kinetic motion.
- Test different blade shapes for aerodynamic efficiency.

TECHNOLOGY

- Use CAD software to design functional mechanical parts.
- Integrate of off-the-shelf and custom-made parts
- Explore manufacturing techniques for real-world applications.

ENGINEERING

- Analyze gear ratios and power transfer.
- Optimize designs for stability and mechanical efficiency.

MATHEMATICS

- Calculate gear ratios and torque outputs.
- Estimate wind power requirements based on blade size.

ADVANCED OPTIONS

For more experienced students, you can challenge them with more advanced concepts and tasks that encourage creativity, engineering principles, and real-world application. Below are some ideas that could be suitable for this level:

- Variable Gear Ratios – Allow students to test multiple gear configurations.
- Alternate Power Sources – Experiment with solar, manual crank, or water power.
- Structural Optimization – Use Finite Element Analysis (FEA) to test stress points.
- Team-Based Prototyping – Assign groups to focus on different aspects like aerodynamics, structural integrity, and cutting efficiency.

By including these advanced design elements, students will be pushed to develop critical thinking skills and a deeper understanding of engineering concepts.