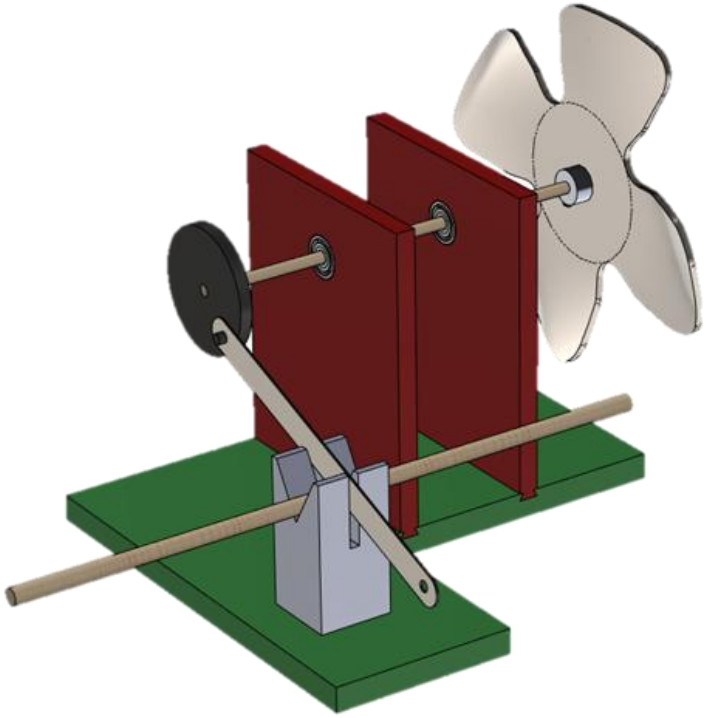
# DESIGN PROJECTS



# WIND-POWERED SAW

## GRADE LEVEL

Grades 9–12

## MODELING TIME

12-20 hours

# MATERIALS

- Wind-catching fan blade or propeller
- Small saw blade
- Bearings
- Pine dowels (3/16" & 1/4")
- Structural materials (e.g., plywood, MDF, or 3D-printed parts)
- CAD software (SOLIDWORKS Design)
- 3D printer (Approximately 500g filament)
- Drill, saw, or laser cutter (for manufacturing parts)

# DESIGN OBJECTIVES

- The machine must use wind power to rotate a cutting blade.
- Students can design the structure and gear system to optimize cutting.
- Aesthetic choices like paint, engravings, or decorative features are encouraged.

# EDUCATIONAL CONCEPTS

### ENGINEERING PRINCIPLES

- Mechanical energy conversion
- Lever mechanics and cutting forces

### PHYSICS CONCEPTS

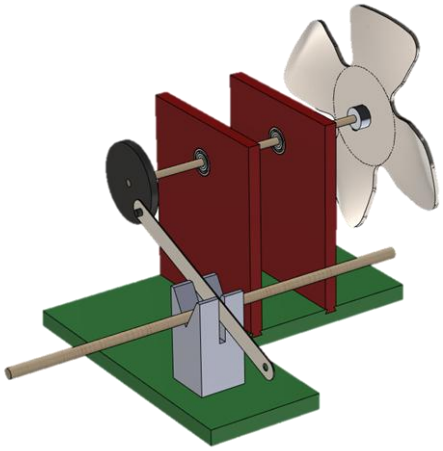
- Torque, friction, and rotational dynamics
- Energy transfer and efficiency

### TECHNOLOGY

- CAD design for custom components
- Integration of off-the-shelf and custom-made parts

### PROBLEM-SOLVING

- Designing systems to achieve specific outputs (cutting a dowel cleanly).



# DESCRIPTION

Using a combination of purchased components like a fan blade, bearings, and a saw blade, along with custom-designed parts created in CAD, students will explore the mechanics of energy transfer and rotational motion.

# HISTORY

The windmill is one of humanity's oldest machines, dating back to the 9th century, used for milling grain and pumping water. This project draws inspiration from those early wind-powered mechanisms, teaching students how wind energy can be harnessed to perform mechanical tasks.

# LESSON TOPICS

### Phase 1: Planning and Research

- Understand the goal: Use wind energy to power a blade capable of cutting wooden dowels.
- Sketch initial ideas for transferring wind energy to the cutting mechanism.
- Identify which parts will be purchased (e.g., fan blade, bearings) and which will be custom-made.
- Optional: Have students research and procure components (fan blade, bearings, etc.)

### Phase 2: CAD Modeling

- Create a base and frame to support the components, ensuring stability during operation.
- Use CAD to design custom shafts, gears, or pulleys.
- Test the fit and alignment of purchased parts within the assembly using in-context design.

### Phase 3: Prototyping and Assembly

- Manufacture structural components using a 3D printer, laser cutter, or hand tools.
- Assemble the parts, ensuring they are securely mounted.
- Connect the mechanical system, ensuring proper alignment and smooth motion.

### Phase 4: Testing and Iteration

- Test the machine in a controlled environment with a fan or natural wind.
- Observe if the dowels are cut cleanly and if adjustments are needed (e.g., blade alignment, torque increases).
- Iterate on the design based on test results.

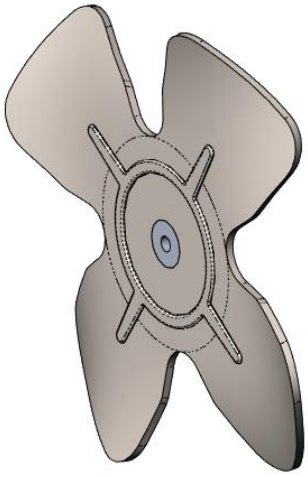
### Phase 5: Presentation

- Explain the design process, challenges faced, and how they were resolved.
- Demonstrate the machine's functionality.

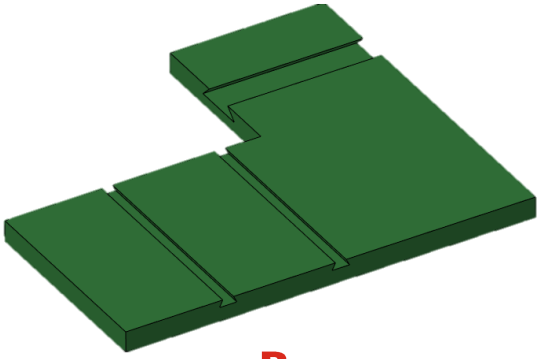
# DISCUSSION STARTERS

- What are the key factors that influence how much torque the fan blade produces?
- How can gears or pulleys be used to increase the cutting force?
- How do design choices impact energy efficiency and material usage?
- What safety considerations must be made when designing machines like this?

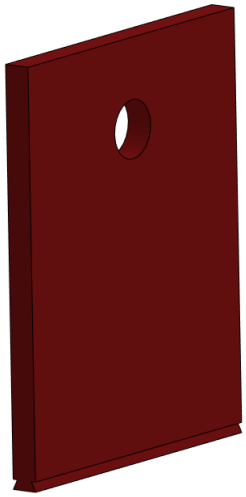
# COMPONENTS



Fan



Base



Support (2x)



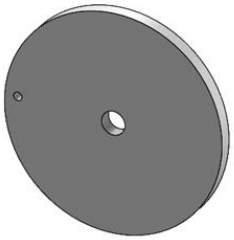
Dowel (2x)



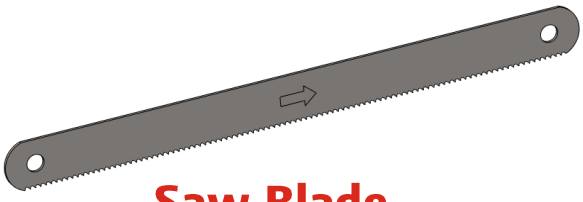
Screw



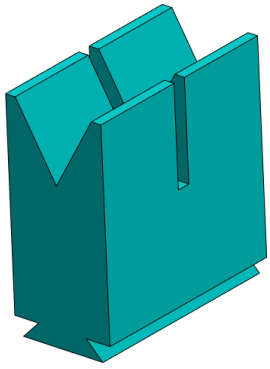
Bearing (2x)
(Match ID to Drive shaft)



Crank



Saw Blade



Dowel Holder

# ADVANCED OPTIONS

- **Power Optimization:** Add gears or a belt system to adjust rotational speed or torque.
- **Energy Storage:** Incorporate a flywheel to store energy for smoother motion.
- **Alternative Power Sources:** Experiment with different energy sources like a hand-crank or a motor.

# ASSESSMENT CRITERIA

- Do the components fit together and function as intended?
- Does the machine successfully cut dowels?
- Does the machine have a unique, innovative, and aesthetically pleasing design?
- Did the student present their design clearly and discuss challenges and successes?

# ADDITIONAL RESOURCES

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