Go Guide

Mini Wind Turbine

WHOOOSH!

Learn about wind energy by designing your very own Mini Wind Turbine!

You Are Here

Choose how you would like to complete this activity.
Download documents & videos at teachergeek.com/miniwind

Go Guide

Start here! Build your Mini Wind Turbine, evolve your design, and begin the Voltage Challenge!

Optional Labs

-Blade Design Lab (Ages 8+)

Optional Challenges

-Wind Speed Challenge*
-Wind Direction Challenge*
-Environmental Challenge*

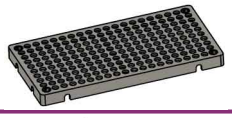
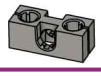
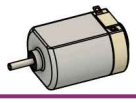
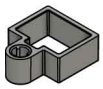
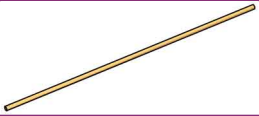
*See Page 7

Go Guide — Mini Wind Turbine

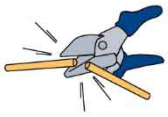
Supplies

TURBINE PARTS

These are the parts you need to build one Mini Wind Turbine, plus some extras, so you can make your own unique designs.

NAME	QTY	PICTURE
Hole Plate SKU 1821-32	1	
Blocks SKU 1821-34	2	
Nuts # 10 Hex SKU 1821-25	1	
Screws 25 mm (1 in) SKU 1821-22	1	
Mini Hub Screw SKU 1821-66	1	
Mini Hub Cover SKU 1821-66	1	 Maker Cart Users: These are the **Red Hubs**, not the Green Hubs.
Mini Hub Base SKU 1821-66	1	
Motor 1.5V – 3V SKU 1821-75	1	
Motor Mount Small 1.5V – 3V SKU 1821-69	1	
Folder (for blades)	1	
Project Sticks various sizes SKU 1821-17 & 1821-18	12	 Stick Sizes 6x 25 cm (10 in) 6x 10 cm (4 in)
Dowels various sizes SKU 1821-20	3	 Dowel Sizes 1x 30 cm (12 in) 1x 15 cm (6 in) 1x 5 cm (2 in)

Have a Maker Cart? Use Multi-Cutters to cut your own dowels.

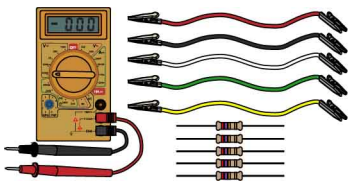


MATERIALS YOU SUPPLY

- **Phillips Screwdriver**
- **Fan**
- **Digital Multimeter** (to measure voltage generated)
- **4x Alligator Clip Leads** (*optional* – for connecting Multimeter)
- **2.7 Ω Resistor** (*optional* – to smooth voltage readings)
- **Tape**
- **Recycling Materials** (to use as turbine blades)

Do you have a …

Turbine Test Kit

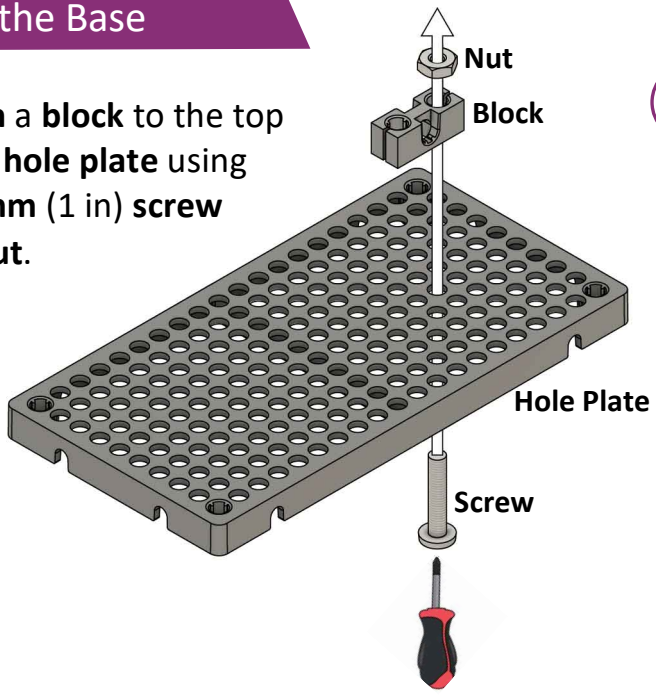


Get everything you need to test your turbine in one convenient kit!

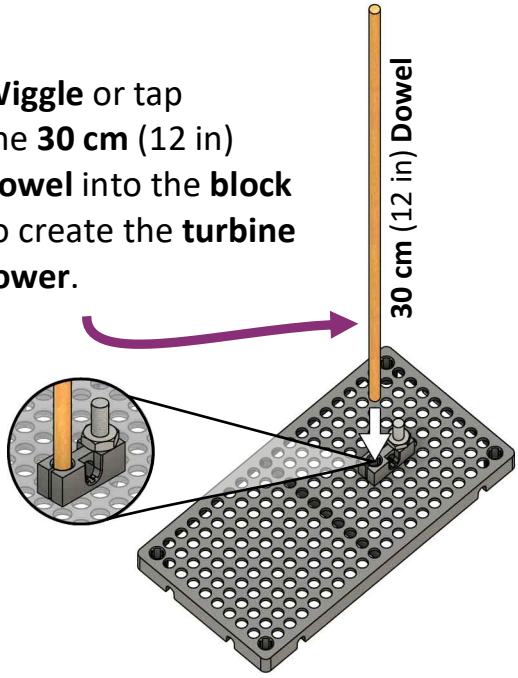
SKU 1823-68

Build the Base

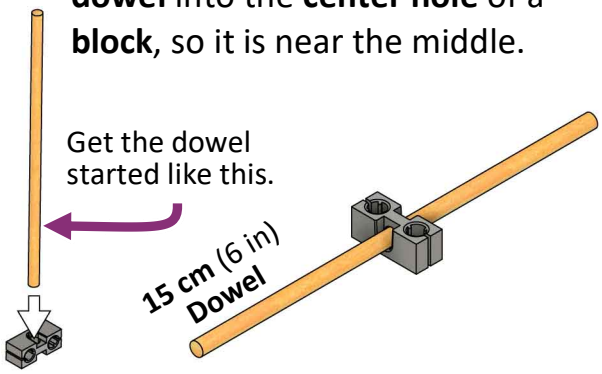
1 **Attach** a **block** to the top of the **hole plate** using a **25 mm** (1 in) **screw** and **nut**.



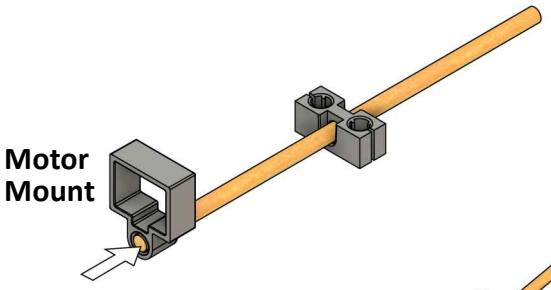
2 **Wiggle** or tap the **30 cm** (12 in) **dowel** into the **block** to create the **turbine tower**.



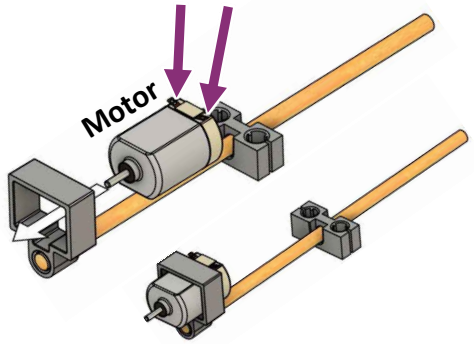
3 **Wiggle** or tap the **15 cm** (6 in) **dowel** into the **center hole** of a **block**, so it is near the middle.



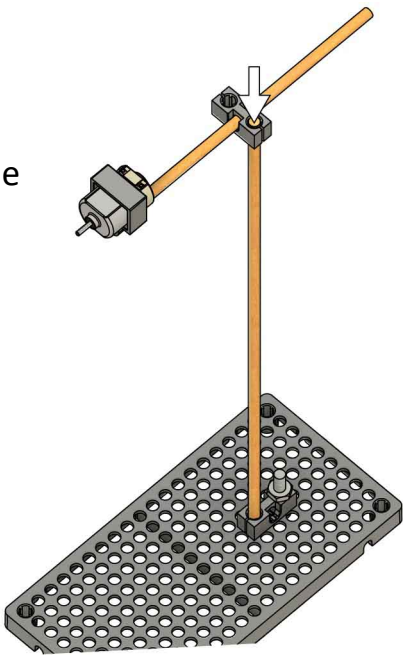
4 **Push** or tap the **motor mount onto** the end of the **dowel.**



5 **Wiggle** or push the **motor into** the **mount** so the **terminals** face up.

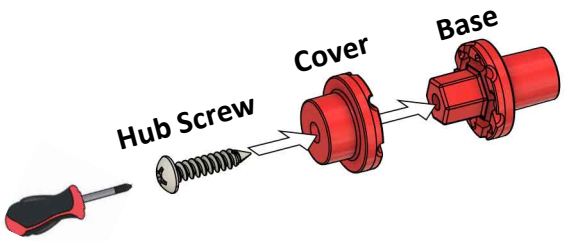


6 **Push** or tap the **block onto** the **tower**.

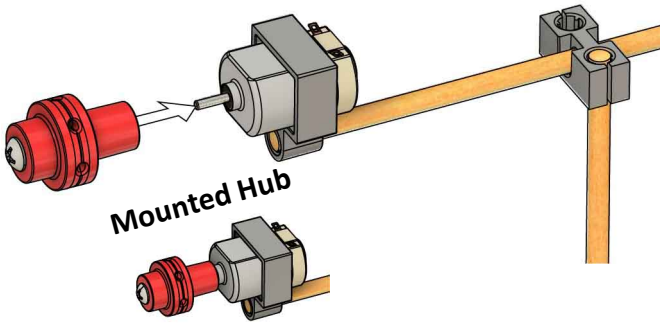


Add the Rotor

7 **Attach** the **hub cover** to the **base** with the **hub screw**.



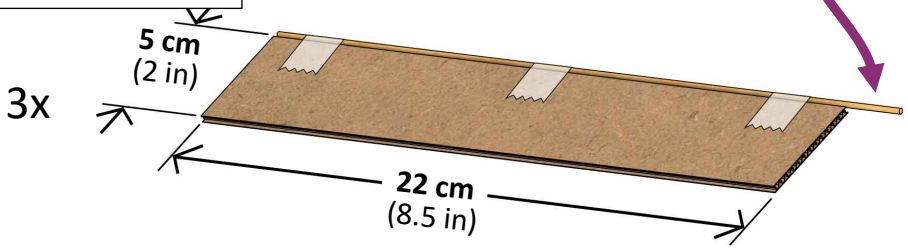
8 **Push** the **hub** onto the **motor** axle.



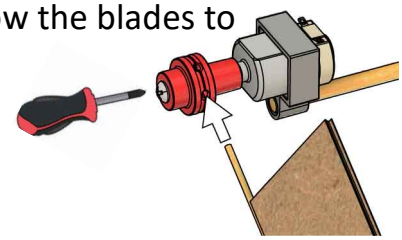
9 Cut **folder** into **three** 22 cm x 5 cm (8.5 in x 2 in) **pieces**

10 **Tape** a **project stick to** each **edge**, leaving some **extra** on one side.

If you're doing the **Blade Design Lab**, **don't alter your blades yet!** You'll do that in the lab.

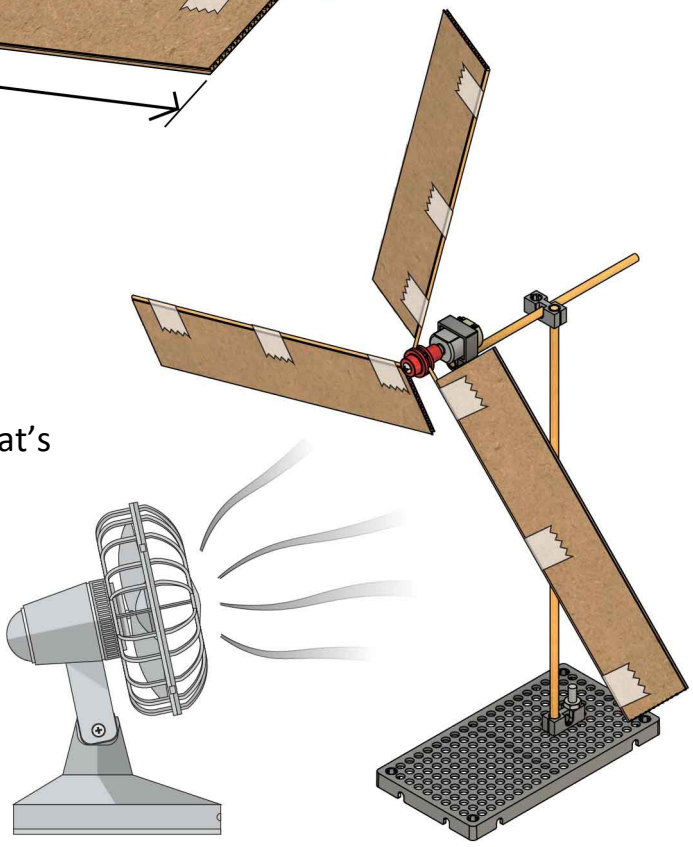


11 **Loosen** the mini hub **screw** just enough to allow the blades to be pushed in.



12 **Add the blades**, being sure to **angle them** (that's what will make them spin).

13 **Tighten** the hub **screw** and **test it out!**



☑ **Your turbine is done, but you aren't.**
Keep reading to learn how to test your turbine, then do a lab or challenge!

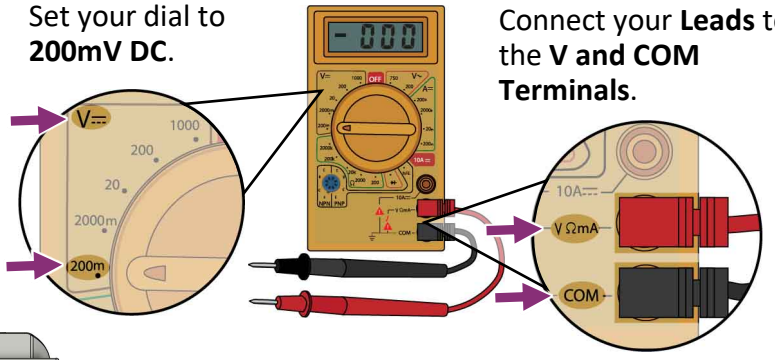
Testing

How well does your turbine work? Hook up a Multi-Meter to find out!

You are going to hook up a Multi-Meter to your turbine to measure the voltage it generates – the faster your blades spin, the greater the voltage will be. More volts means more power!

13 Set up your meter.

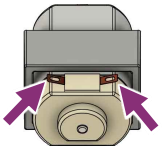
Set your dial to **200mV DC**.



Connect your **Leads** to the **V and COM Terminals**.

14 Connect your meter.

You will **connect** your **meter** to the **terminals** of the motor/generator.



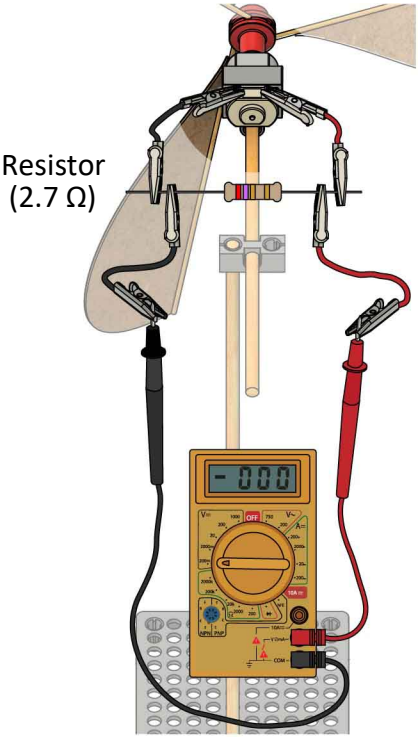
There are two ways to connect your meter. Option 1 is a little bit easier to set up, but Option 2 fluctuates less when testing.

Option 1: Multimeter Only

OR

Recommended

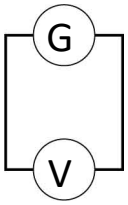
Option 2: Meter & 2.7 Ω Resistor



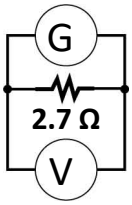
Circuit Diagrams:

Can you figure out what the symbols mean?

Option 1



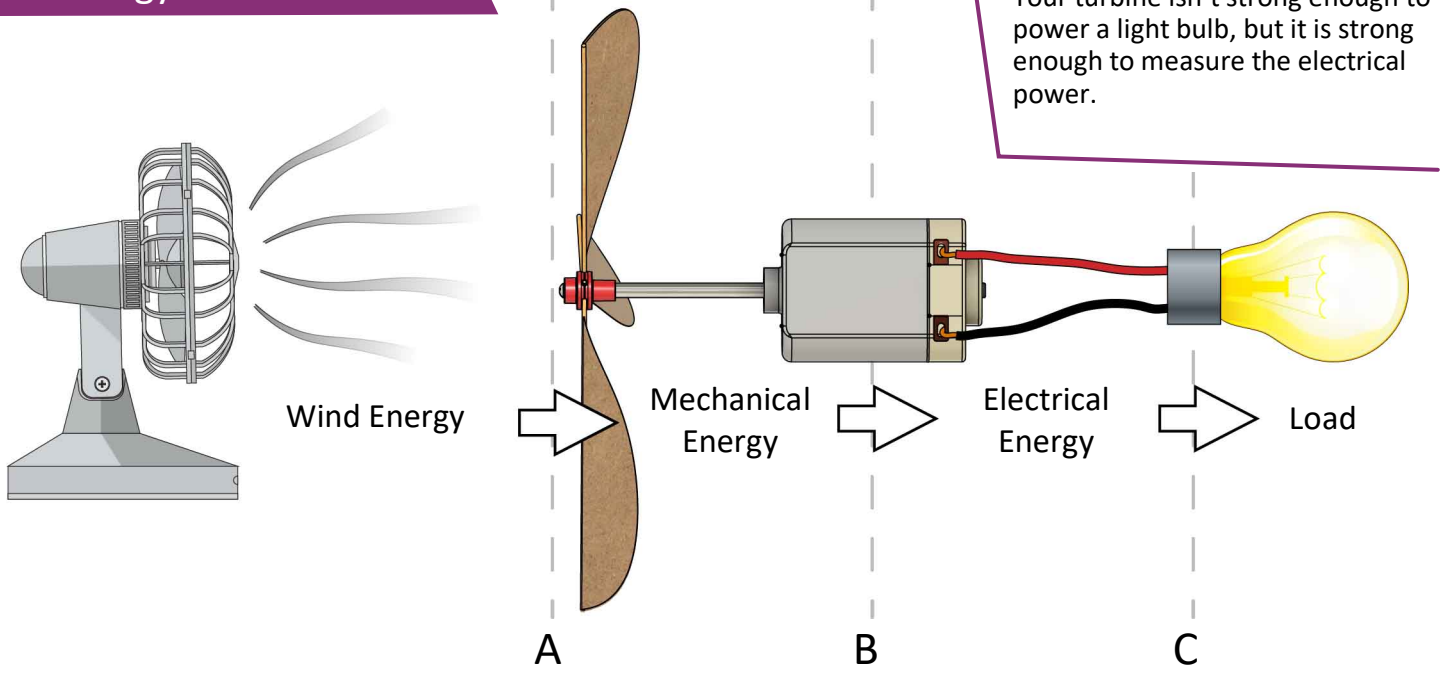
Option 2



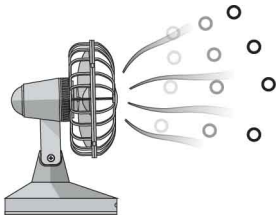
Energy Transfers

Note:

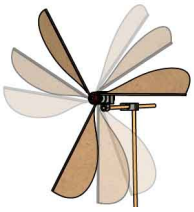
Your turbine isn't strong enough to power a light bulb, but it is strong enough to measure the electrical power.



A The **Turbine Blades** convert Wind Energy to Mechanical Energy.



Wind Energy is really Kinetic Energy – it's the energy of the moving air molecules.



Mechanical Energy is the Kinetic and Potential Energy of the spinning turbine blades.

B The **Generator** converts Mechanical Energy into Electrical Energy.

When the **Generator** (motor) spins, the wire coils and magnets inside create electricity.

Electrical Energy is the energy of electricity (electrons traveling through the wires).

C The **Light Bulb** uses the Electrical Energy, so it's called the Load.

Loads are anything that uses electrical energy, like your TV, vacuum cleaner, and phone.

Only one of the turbine testing options, from Page 4, has a load. Which one? What's the load?

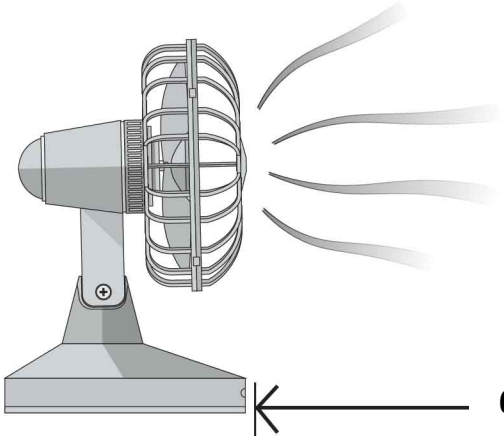
Voltage Challenge

The design that generates the greatest voltage wins!

Constraints:
(rules and limits for your design)

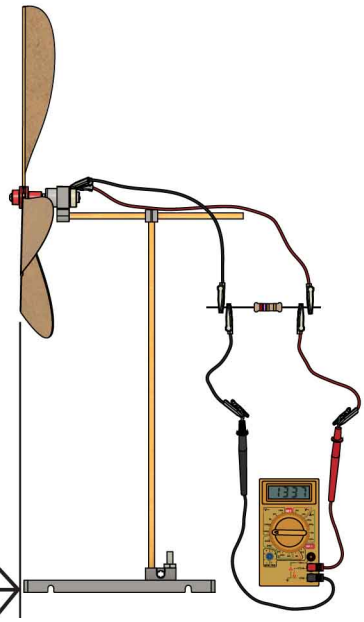
Setup:

The **fan** must be the **only power source** for your turbine.



60 cm
(24 in)

Your **wind turbine** must be at least **60 cm** (24 in) from the **fan**.



All designs must use the **same testing circuit**.

See Page 5 for testing setup.

Materials:

You may only use the supplies listed on Page 1.

You can use as many recycling bin materials as you want!

You must design your own blades.

You may not use pre-fabricated blades (e.g. from a pinwheel).

Blades must not be dangerous (e.g. metal, sharp edges, etc.).

Additional Challenges

You finished the Voltage Challenge and want more? Try one of these! Use the same setup and material constraints as the Voltage Challenge.

Wind Speed Challenge:

Each competitor does **three trials**, back-to-back, with different fan speeds (**Low, Medium, High**). There is a **1 minute adjustment period** between trials to swap/adjust the blades for each speed.

The turbine that generates the greatest voltage wins!

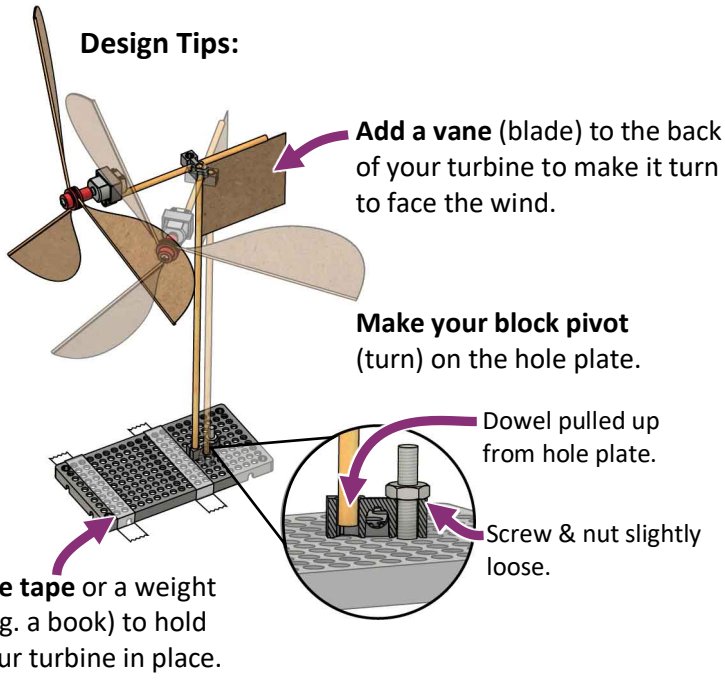
Wind Direction Challenge:

An opponent places your turbine 60 cm (24 in) from the fan, turned whichever way they want. **Your turbine needs to use wind power to rotate and turn into the wind.**

The turbine that generates the greatest voltage wins!

Weather vanes turn to face the wind – can you make your turbine do it, too?

Design Tips:



Environmental Challenge:

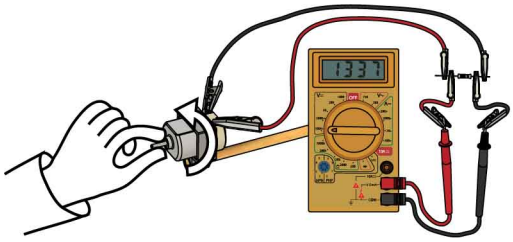
Wind turbines are criticised for looking ugly and killing birds. **Modify your turbine to look nice in nature and have safety features to protect birds from the blades.**

Tuning Your Turbine

Want to generate more voltage? You need to spin the generator fast!

Test it out!

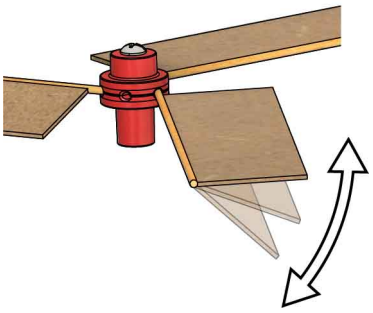
Try **spinning the shaft at different speeds** in your fingers, and check the reading on the meter.



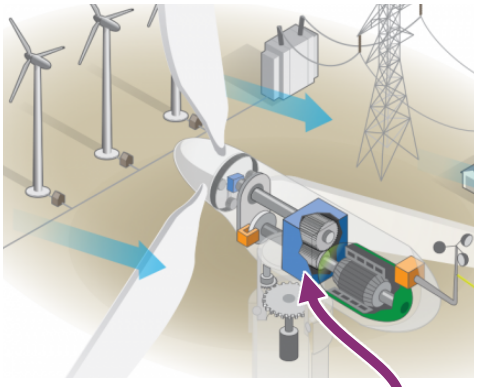
Resistor Optional

What makes it spin faster?

Blade Angle

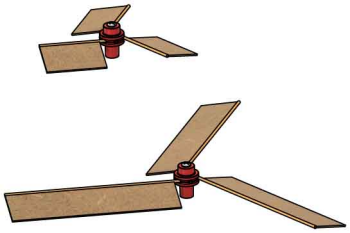


Blade angle is the most important variable, and it's also the easiest to change! **Try shallow and deep angles – what works best?**

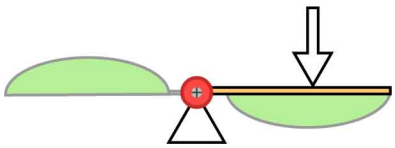


Full size wind turbines use **gears** to spin the generator quickly, even though the blades move slowly. Gears trade **torque** for speed, like levers.

Blade Length

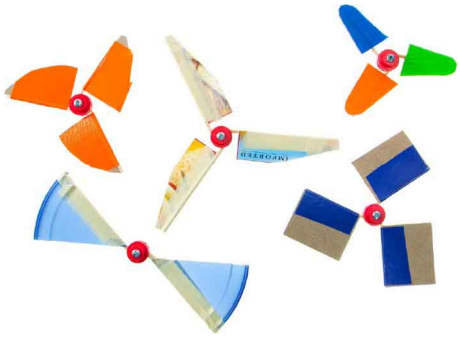


Each blade acts like a lever turning your generator. **What works better for speed – long or short blades/levers?**



Torque is turning force.

Other Variables



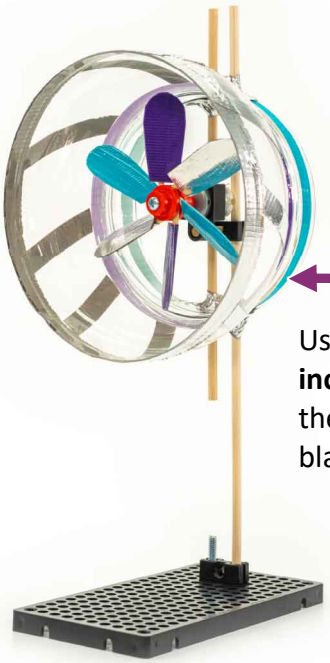
Once you figure out how blade length and angle affect your turbine, **try changing the shape and number of blades.**

Optional Lab

Want to learn more about turbine blade designs?

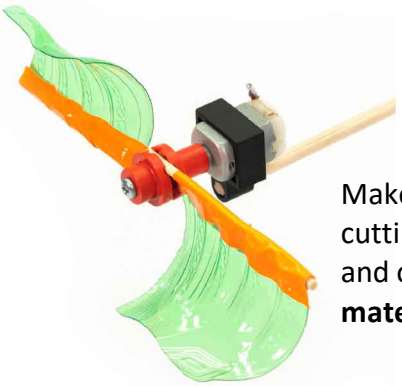
Download the **Blade Design Lab** at **teachergeek.com/miniwind**
Ages 8+

Inspiration

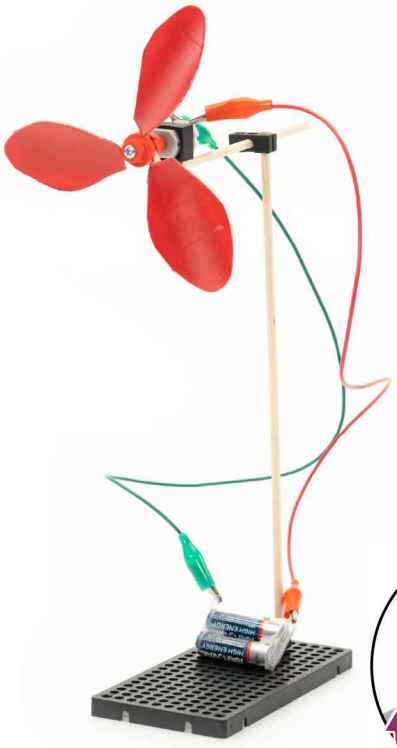


Use a **shroud** to **increase** the speed of the **wind** hitting your blades.

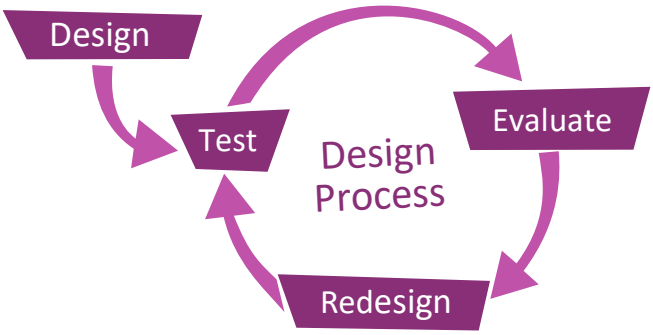
Vertical Axis Turbines work no matter what direction the wind comes from!



Make unique **3D shapes** by cutting up plastic bottles and other **recyclable materials**.



Make a fan by using 1 or 2 AA **batteries** to power your motor.



There is no perfect design.
The design process never ends!