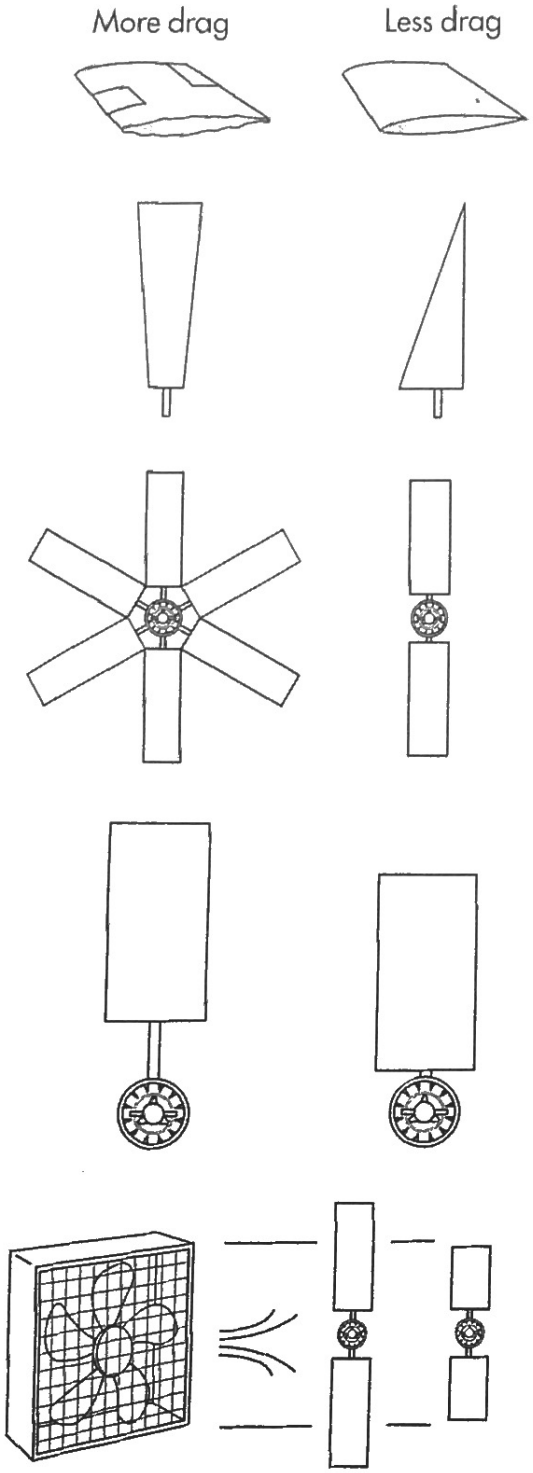


More power: Improve your blades

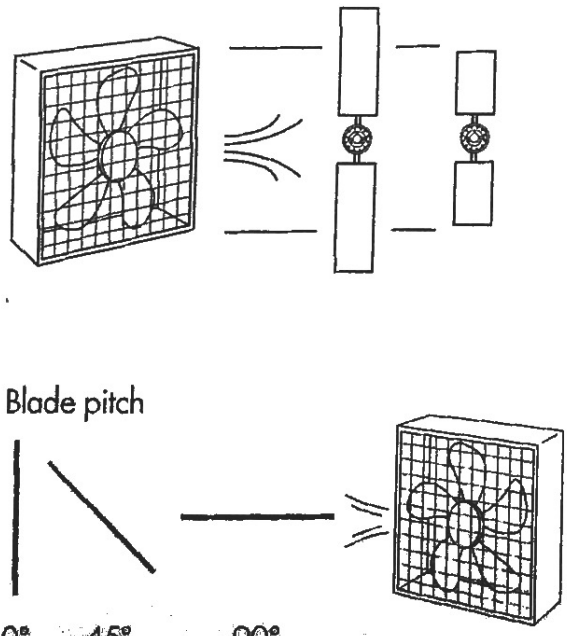
KidWind wind turbines are designed for use in science classes or as a hobby or science fair project. They were created to allow students a method to perform blade design experiments. Our turbines are not specifically designed to light bulbs, spin motors, or charge batteries, but they can if you have a good fan and manage to design efficient blades.

Having efficient blades is a key part of generating electricity from a wind turbine. Sloppy, poorly made blades will never make enough electricity to do anything. It takes time and thought to make good blades.

One thing you must always think about when making turbine blades is: "How much drag are my blades encountering?" Sure, your blades are probably catching the wind and helping to spin the hub and motor driveshaft, but could they be spinning faster? If they are adding drag, your whole system will slow down. In most cases, low RPM means less power output. The faster the blades spin, the more power you make!

Quick tips on improving blades

- Shorten blades: Many times, students make very long blades, thinking bigger is better. That is sometimes true, but students and teachers have a very hard time making long blades without adding drag. Try shortening them a few centimeters.
- Change the pitch: Often, students will set the angle of the blades to around 45° the first time they use the turbine. Try making the blades more perpendicular to the wind flow. Pitch dramatically affects power output. Play with it a bit and see what happens.
- Use fewer blades: To reduce drag, try using 2, 3, or 4 blades.
- Use lighter material: To reduce the weight of the blades, use less material or lighter material.
- Smooth surfaces: Smoother blade surfaces experience less drag. A blade with lots of tape and rough edges will have more drag.
- Get more wind: Make sure you are using a decently sized box or room fan, one with a diameter of at least 14"–18".
- Blades vs. fan: Are your blades bigger than your fan? This could be a problem, as the tips of your blades are not catching any wind and are just adding drag.
- Blade shape: Are the blade tips thin and narrow or wide and heavy? The tips travel much faster than the roots. Wide tips add drag.



Advanced blades

Two major forces act on wind turbine blades as they rotate: lift and drag. These forces are in constant competition. When you are optimizing wind turbine blades, try to maximize lift force but minimize drag force.

Wind turbine blades are airfoil shaped, much like airplane wings. This airfoil shape is designed to generate lift and minimize turbulence.

Lift is primarily produced as a result of the angle-of-attack of the blade. This angle creates a deflection force on the upwind side and a vacuum force on the downwind side of a wind turbine blade. The deflected air causes a reaction force that pushes the blade.

Turbine blades are tapered more at their tips and are also twisted slightly. Because of this twisted pitch, they have a greater angle-of-attack near their root where rotational velocity is slowest. Velocity is higher at the tip of the blade, so the angle-of-attack there is smaller. Turbine blades are designed in this manner to optimize the balance between lift and drag at all points on the blade.

Most real wind turbines use two or three blades. This configuration allows them to capture the most power with the least wind resistance. Using the fewest number of blades possible also reduces cost. The actual angle and taper of the blades depends on the anticipated wind speeds at the turbine's location.

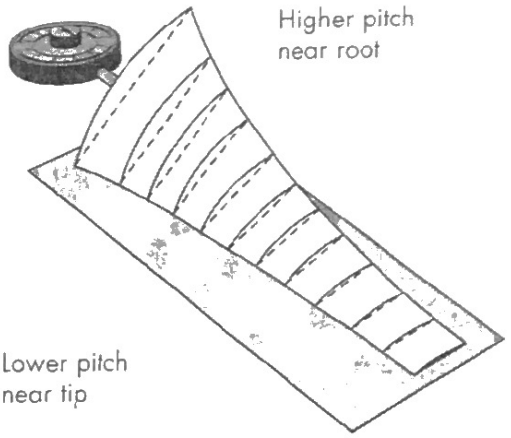
KidWind blades

Flat blades create a great deal of torque, and therefore work well for weight-lifting experiments. Airfoil blades have less drag and can generate more power. You can make more sophisticated blades by giving them twisted pitch and an airfoil shape.

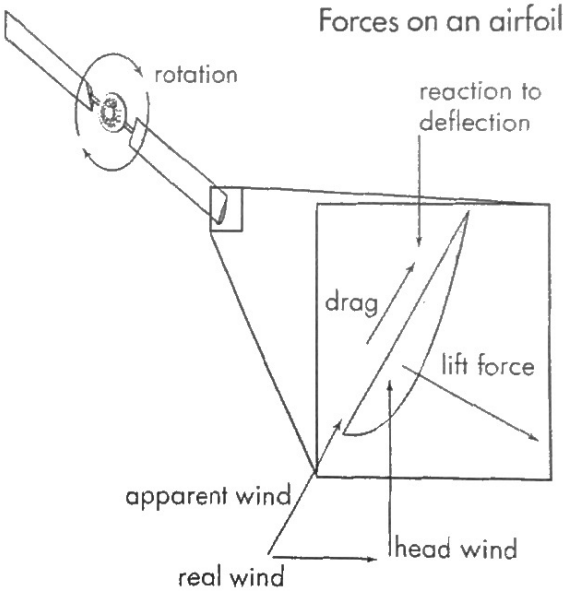
Ideas for constructing advanced blades

- Bend card stock into an airfoil shape. Glue a dowel inside the blade.
- Tape bent card stock to a flat piece of corrugated plastic or balsa wood to produce an airfoil shape.
- Take a block of foam and form it into an airfoil shape. Try to incorporate both a taper and a twist into the design.
- Carve and sand a piece of soft wood into an airfoil.
- Cut blades out of some form of cylinder. Try a cardboard tube, a paper or plastic cup, etc.
- Soak card stock in water for a few minutes. Form it into the desired shape and clamp or tape it in place until it dries and holds that shape.

Twisted Pitch



Forces on an airfoil



Using the KidWind Protractor