



WIND WEIGHTLIFTING CHALLENGE

Before wind energy was used to generate electricity, it was used to do physical labor. Goods and people were transported using wind power. Old windmills ground grain into flour and wind power was used to pump water for livestock and farming. This challenge focuses on using wind energy to do physical work by lifting paper clips.

This activity is based on *Wind Can Do Work*, an activity found in NEED's wind curriculum guides. You can construct towers based on this design, using cups and straws and a blade template, or you can have students come up with their own design completely from scratch. Essential materials include string or thread and paper clips. Additional materials can be provided based on what is available. A list on page 3 provides some inspiration. It is often fun to provide detractor materials, or materials that may not appear to be useful, as students can work through the challenge and refine their design.

Design Parameters

- Wind turbines, from the bottom of the base to the highest point of the blades in their highest position, can be no more than 25 centimeters.
- All turbines must have no fewer than 3 and no more than 5 blades.
- The turbine must be able to turn on its own when the fan is turned on. No hands-on assistance to overcome inertia is permitted.
- Paper clips must be lifted at least 15 centimeters. This means the lifting mechanism must be able to clear a little more than 15 centimeters.

Testing Parameters

1. Use a fan on medium speed. (If a high velocity fan is used, it may be necessary to start at low speed.)
2. Count the number of paper clips the turbine can lift in a two-minute period. Clips must have completely left the ground or table and have been lifted completely to the top of the lifting mechanism.
3. Paper clips that fall while being lifted do not count.

Teachers' Cheats

These are some things that you will know that your students will not know, that can help you spur the students' creativity and thinking:

- Blades should be inserted in the hub at an angle. Flat blades will not spin consistently.
- If a paper pinwheel turbine is used, it may need to be secured in front of and behind the turbine to keep it from blowing backward on the rotor. This can save many minutes of frustration for your students.
- Provide protractors and rulers so students can evenly space their blades on their rotor assembly.
- Gears are excellent maximizers of efficiency as are pulleys. Building toys have parts that can be used this way.
- Power equals work done divided by the time taken to do the work. Students do not have to lift all their paper clips all at once. They can remove paper clips that have been lifted the full distance, lower the lifting mechanism, and continue.