



WeightLifter Wind Turbine

Parts Only Kit
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WeightLifter Wind Turbine (Parts Only Kit)

Parts List:

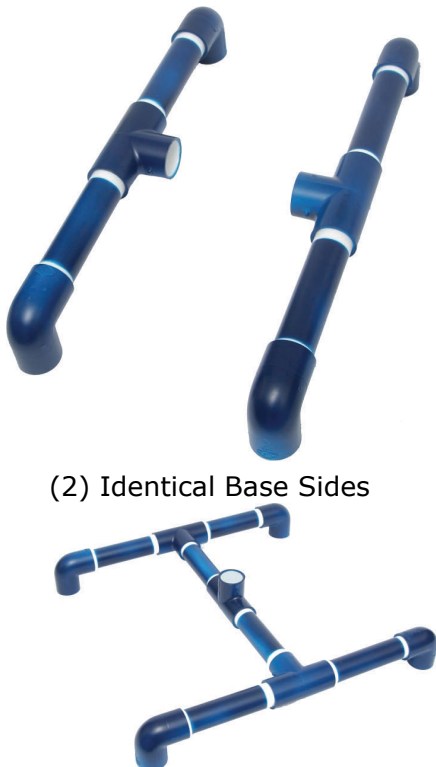
- (1) PVC 1" T-Fitting
- (2) PVC 1" Slip Cap (drilled)
- (3) 2" Length of HDPE pipe
- (1) 12 Hole Crimping Hub
- (1) 10" Hex Driveshaft with Hub Quick-Connect
- (1) Small Plastic Bucket
- (1) String (4')
- (2) Wooden Spools (large and small)
- (30) Weights (Washers)
- (2) Hex-Locks (green)
- (1) Spool (hourglass)
- (12) 1/4" Dowels

The WeightLifter Turbine is designed to explore how well a wind turbine can move heavy objects. Before there were electrical generating wind turbines, windmills were used to grind grain, pump water and saw wood—today many windmills are still used to do these jobs. The wind machines often required the designers to create blades and drive trains that could move large stones, gears, or heavy water. These instructions will show how to build the WeightLifter and conduct a few simple experiments.



How To Build a PVC Tower (Not Included)

1. Using (4) 90° PVC fittings, (2) PVC Ts and (4) 6" PVC or HDPE pipe sections, construct the two sides of the turbine base.
2. Fit the parts together without using glue (PVC glue is really nasty stuff). To make them fit snugly tap them together with a hammer or bang them on the floor once assembled.
3. Next, connect the two sides of the base using another PVC T fitting.
4. Use a 24" section of PVC or HDPE pipe as your tower. Connect it to the PVC T fitting in the middle of the base.
5. Attach your weightlifter nacelle on top of the 24" tower.

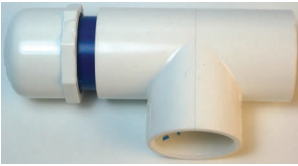


(2) Identical Base Sides

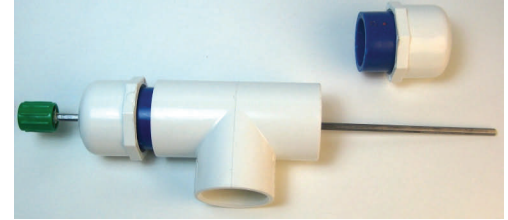


Building the Weightlifter Nacelle (Head)

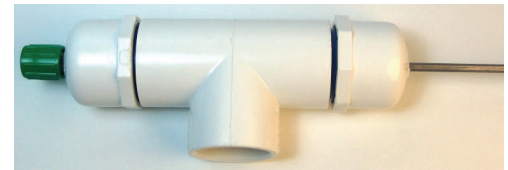
1. Insert one 2" section of HDPE pipe into each drilled PVC Slip Cap.



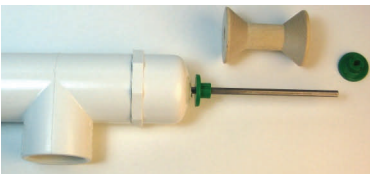
2. Insert the other side of one 2" HDPE pipe into one side of a PVC "T" fitting.



3. Push the steel hex driveshaft through the drilled hole on the PVC Slip Cap. The green Hub Quick-Connect will end up next to the slip cap.



4. Slide the steel driveshaft through the 2" HDPE section and out the drilled hole of the second PVC Slip Cap. Attach the KidWind Crimping Hub to the Hub Quick-Connect. The hub and driveshaft should



5. Push one of the hex-locks onto the back of the steel driveshaft. This hex-lock can push down until it is almost touching the PVC Slip Cap. Make sure the flange is facing backwards—as the spool will lock onto this flange.

6. Insert one of the wooden spools behind this pulley. The diameter of your spool will affect the mechanical advantage of your windmill. We will discuss this more later!



7. Push the second green hex-lock behind the wooden spool to secure it in place. This time the flange should face forward to lock into the spool.



8. Tie, tape or glue the string to the wooden spool so that it will wind up when the hub rotates.

9. Attach the other end of the string to the plastic cup. Your weightlifter nacelle is now complete. Time to build some blades!



What can you do with your turbine?

Factors that Affect Power Output

How much power is your wind turbine producing? The weightlifter turbine uses simple machines (pulleys, wheels) to transform the energy in the wind to lift heavy objects. There are two factors that determine how much power your turbine is producing: (1) How much weight it can lift, and (2) How fast the weight is lifted. Look at the next page to learn more about power in the wind and how to get the most out of your turbine. Once you have read through the materials, start experimenting! What factors can you change to increase the power output of your turbine?

Here are a few ideas for starters.

- *Wind Speed*
- *Blades*
- *Diameter of driveshaft, adding gears, etc.*

Wind speed is an easy one. Take your turbine and place it in front of a fan at three different distances. How does the power output change? Why does it change? Make a graph and discuss. Think about this in relation to the Power in the Wind equation.

Blade Design

An entertaining group of experiments involves blade design. The blades on modern turbines "capture" the wind and use it to rotate the shaft of a generator. The spinning shaft of the generator spins magnets near wires and generates electricity. The WeightLifter turbine does not produce electricity, but works in much the same way to convert wind into power. How well you design and orient your blades can greatly impact how much power your turbine produces.

The ideal blade setup for the weightlifter turbine may be different than the ideal blade setup for an electricity producing turbine. When producing electricity, the goal is to make the rotor spin as fast as possible to spin the generator faster. When lifting weights, however, your blades need to provide lots of torque (muscle) not just speed. It can really pay off to experiment with your blades until you find a setup that provides lots of torque and speed.

Experiments with blades can be simple or very complicated, it depends on how deep you want to explore. Some variables you can test with blades include:

- *Blade Length*
- *Blade Shape*
- *Blade Number*
- *Blade Materials*
- *Blade Pitch*
- *Blade Weight*

If you are doing this for a science fair or project you should focus on just one these variables at a time as your results can get confusing quite quickly.

Experimental Ideas

How many bolts can your model lift?

Using your preliminary blade setup and design, how many bolts does your turbine lift? Can you fill the bucket and still lift it? The most efficient turbine will lift a lot of weight with a low wind speed. Try moving your turbine away from the fan or leaving the fan on a low setting. How much weight can you lift now?

Experiment with the number of blades:

For this experiment it is important to keep the pitch of the blades constant.

How many blades did you use? What happens if you only use two blades? Next try three, six blades, even one!! Is there a relationship between the number of blades and the lifting capacity of the turbine? Will six blades lift twice as much weight as three blades? Is there some point where adding blades makes the wind turbine less efficient?

When testing the number of blades, one strategy is to keep the weight constant while altering the blade number. Then measure the time it takes to lift the weight to determine which blade setup gives you the most power. The faster it lifts the weights the more power you are generating.

What blade number gives you the most power? Why?

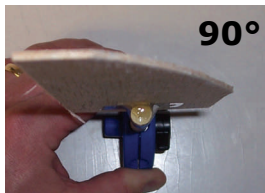
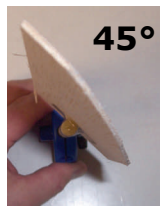
Experiment with the blade pitch:

For this experiment it is important to keep the number of blades constant.

When the blades are flat against the wind (0°), the air will push the blades in the same direction as the wind. This results in a minimum transfer of energy from the moving air. Likewise, when the blades are 90° , or perpendicular, to the wind, there is no push at all from the moving air since there is very little exposed surface. Half way between these two extremes, at 45° , some of the force pushes the arm sideways while some force pushes it backwards. Therefore, in principle, an angle of 45° should provide for the maximum push from the wind...is this true?

Experiment with different blade angles. Again, it might be a good strategy to keep the weight a constant and only adjust your angle. Measure the time it takes to lift the weight as you change your blade pitch.

What blade pitch gives you the most power? Why?



For more experiment ideas, head to www.kidwind.org