



Garden Kinetic Sculpture (Cut List)



4" X 4 ½"
1 ½" Thick

Center Support X 1

Start with one and a half inch thick Ipe wood and cut a rough rectangular block at 4 X 4.5 inches. Alternate wood choices would include White Oak or other dense hardwoods resistant to moisture and wood rot.

3 ¼ X 3 ¼
1" Thick

Wheel Hub X 2

Cut (2) 3 ¼ inch square Ipe blocks and plane then down to 1 inch in thickness. Alternate wood choices would include White Oak or other dense hardwoods resistant to moisture and wood rot.

2" X 6"
½" Thick

Sculpture Leaves X 16:

Cut (16) ½ inch thick Ipe blocks at 2 X 6 inches. Again, alternate wood choices would include White Oak or other dense hardwoods resistant to moisture and wood rot. You can use ¾ inch stock if necessary but it adds weight to the wheel.

Wood Choices:

I used Brazilian Ipe wood for this project but it can be hard to find. It is an oily dense hardwood which makes it perfect for this type of application. Ipe can get wet and will hold up to the stresses of wind and weather. Soft woods like Cedar would most likely break apart as the wind picks up. There are specialty hardwood suppliers that will ship directly to your home, so choose a dense hardwood that they might recommend for outdoor / wet applications. Teak or Mahogany would be great options as well.

Garden Kinetic Sculpture (Other Materials)



(4) Roller blade bearings and (2) Roller blade bearing spacers are needed for the rotational hubs. One set of bearings and spacer will fit tightly in the middle of each windmill hub. See the video for more detail on assembly.



(16) $\frac{1}{4}$ inch brass rods are needed for the windmill, 8 for each spinning wheel. My sculpture used 14 inch rods though in hindsight, 12 inch or 10 inch rods might have worked better to reduce the overall width of the sculpture.



$\frac{1}{4}$ Inch threaded rod (less than 8 inches needed), (4) $\frac{1}{4}$ inch stainless steel washers, (2) $\frac{1}{4}$ inch stainless lock nuts and (2) $\frac{1}{4}$ inch fender washers (optional) to act as trim to cover the bearings. I painted my fender washers with a brass colored paint to match the rods.

Tools:

- Table Saw
- Band saw
- Drill Press
- Sander
- Hack saw + metal file
- $\frac{1}{4}$ inch long drill bit
- 22mm Forstner bit (for bearings)
- Thick CA glue + epoxy
- SAFETY EQUIPMENT: Eye protection, Dust Mask, Ear Protection



Garden Kinetic Sculpture (General instructions)








Please refer to the YouTube Video for the general build steps and please be careful using any power tool, following all safety and operating instructions for each tool you use.

A Note of Caution: I wasn't prepared for how heavy the finished piece was, nor the energy created when the wind really starts driving the wheels. It will hurt you or a member of the family if the spinning wheels hit you. Be sure to place the sculpture in a safe place or remove it from its post if a storm drives higher winds.

Cutting: Follow the pattern cut outs included in this set of instructions, making sure that the dimensions match the measurements provided. You may need to adjust / enlarge your printed patterns depending on your printer settings. Spray glue them on and cut on the lines.

Leaf Shaping: I went to additional lengths to hollow out the back of each leaf and shape the edges, but you don't need to go that far. It's more important that each cut leaf weighs the same so it is balanced on the wheel. A good cut out and some sanding is all you need. You can use $\frac{3}{4}$ inch thick wood if $\frac{1}{2}$ inch is not available or easy to produce.

Drilling: Be sure to center each drilled hole on the drill press.

- Drill a $\frac{5}{8}$ inch hole 2 inches deep on the bottom of the center support "T" structure. That will then take a $\frac{1}{2}$ inch wrought iron post to support the windmill as shown in the video. 
- Drill a $\frac{1}{4}$ inch hole fully through the upper cross of the "T" structure. 
- Drill a 22mm hole with Forstner bit fully through the center of both octagon wheels. 
- Drill $\frac{1}{4}$ inch holes $\frac{1}{2}$ inch deep on all 8 sides of the octagons. 
- Drill a $\frac{1}{4}$ inch hole in the center stem of each leaf $\frac{1}{2}$ inch deep. 

Brass Rod Bending:

You don't actually need to bend your brass rods to complete this sculpture, it was just an artistic choice. That, and as you saw in the video, they break if you try to bend them too much. If you like the curved look, try and find a wide tree or post, wear thick gloves, safety glasses and bend them slightly, checking the curvature to make sure they all match. After bending, score the ends of each rod with a metal file about a $\frac{1}{4}$ inch up to give the epoxy something to grab on to.

Leaf Angles:

From the video and with some research on optimal windmill blade angles, you'll need to create a helpful template that is fixed at 35.5 degrees so that your glued leaves are all set properly to catch the wind. See the video for how this was accomplished.

Glue Choices:

I chose to use thick CA glue to adhere the bearing assemblies inside each octagon wheel, and used it again to attach the brass rods and leaves. You can use epoxy, but you will have to make sure the leaves and rods don't move while the epoxy is curing. Medium/Thick CA allows for a fast bond and fills the void to seal each drill hole.

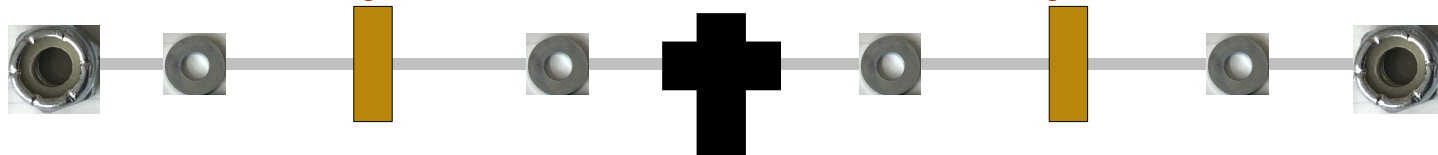
Garden Kinetic Sculpture (Assembly Narrative)

Once the wood pieces are cut and sanded, proceed to drilling out the holes as outlined on the previous page. Each hole should be centered on the part of the wood block being drilled and the depth needs to be precise to avoid impacting other parts of the assembly. For example, if you drill one or more of the octagon rod holes too deep, the wheel will be off balance.

Wearing protective latex gloves, take the bearing assemblies (2 bearings inserted into the spacer) and glue them evenly into each octagon core. Use the CA glue sparingly on the inside of the wood block, enough to coat and connect with the bearing ring, but not foul the movement of the inner bearing core.

Layout the hardware for the center structure and confirm the ¼ inch threaded rod will pass through the “T” on the block. Attached to the rod in order from left to right:


Lock nut – washer – octagon hub – washer - “T” structure – washer – octagon hub – washer – lock nut.




Check the length of the threaded rod. It should be long enough to allow attachment of the nuts on both sides without extending beyond either nut. Trim the rod with a hack saw and smooth out the jagged edges with a metal file. Disassemble the octagon hubs for the next step.

Prepare the post or stake you will use to support the sculpture. I repurposed a ½ inch iron garden hook and cut off the end hook to give me a straight post with 2 stakes that could be driven into the ground. A similar post or pipe solution will work too, if it fits between the wheels and into the center “T”.

Determine your desired direction of spin and the orientation of the front and back wheels. The angle of the leaves (like a fan blade) should be set up to spin in the direction you want. The curved rods need to be situated and planned for glue up in your desired location too. Play with the setup on a flat table before you glue anything.

Option A:  Front/back rods curving the same way.

Option B:  Rods with opposed curves

Glue up: It will help if you can find a thin board or cardboard to support the brass rods at the same level where they attach to the octagon hub. See the video where a thin wooden sheet holds the rods flat while they are glued into the octagon hub. Glue in each of the 8 pre-bent brass rods into each hub in the orientation you desire. Wait for the bond to cure. Next using your 35.5 degree measuring tool (even a cut piece of cardboard will work) glue in each leaf on the ends of the brass rods and align the leaf angle with your 35.5 degree tool. All leaves need to be tilted in the same direction.

You're almost done! Depending on the wood you choose, you may or may not need to add an exterior finish to help protect the wood. The more oily the wood species the better, but you can plan to add a safe exterior oil finish annually to protect it further. Complete your assembly by adding the finished hubs back on the center “T” support structure with the washers and nuts in the same pattern as tested before. Secure your center post into the ground in a safe garden spot where the spinning wheels won't hit anything or anyone! Place the sculpture onto the post and wait for wind. If the wheel is balanced, a light breeze is all that is needed to drive the wheels. Send us a note to tell us how your project went! Best always - TFW

Sculpture Drawing Cut Outs

