



instructables

# Planet Prop Suspension System



by rsvpheavenlyengineers

All materials needed for this project are in the images in this section.

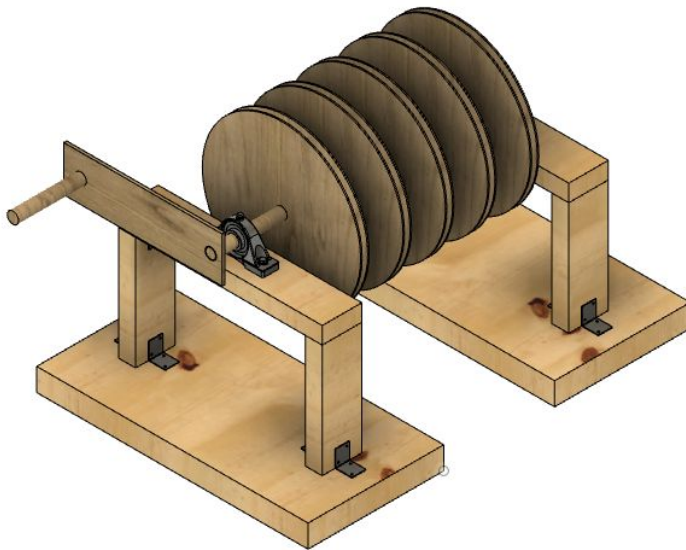
For ease of use each step in this instructable is labelled with the respective name shown in the materials list.

Next to each item is the number of each of those items you will need to purchase along with the respective price and website/store to buy from

Items without prices are either assemblies or parts

that will be self made from purchased materials

First you must decide how big you want this system to be. This will help to figure out how much material you will need. The number of planets/balls controlled by the system will dictate how many "Wind-up Rods" you will need to build and how much material you need overall. The following procedure describes a system five planets on each wind-up rod; however, the wind-up rod is modular so, it can have less than 5 planets associated with it.



Final Assy							
Wind Up Rod							
Support Structure							
wood 2x4	1	2.97	2.97	Home Depot	96 inch whitewood		
Lower Legs	4				Self Made		
Mount Block	2				Self Made		
wood 2x12	1	15.42	15.42	Home Depot	96 inch whitewood		
Base	2				Self Made		
Angle Frame Anchor	12	0.68	8.16	Home Depot	item 23-4509		
Screws	1	7.98	7.98	Home Depot	72 Screws		
Pillow Block Bearing	1	15.75	15.75	Amazon	2 Pillow Blocks		
25 1/4-20 Hex Bolt	1	5.92	5.92	McMaster	PN # 92240A552		
50 Hex Nut	1	2.27	2.27	McMaster	PN # 92673A113		
25 Washer	1	9.60	9.60	McMaster	PN # 91525A416		
Shaft							
1 Inch Wood Rod	1	3.98	3.98	Home Depot	48" long (6416U)		
12 inch disk assembly							
12in Discs	2	5.50	11.00	Woodpeckers	1/2 in		
14in Discs	4	2.60	10.40	Woodpeckers	1/8 in		
10 inch disk assembly							
10in Discs	2	5.50	11.00	Woodpeckers	1/2 in		
14in Discs	4	2.60	10.40	Woodpeckers	1/8 in		
8 inch disk assembly							
8in Discs	2	2.25	4.50	Woodpeckers	1/4 in		
14in Discs	4	2.60	10.40	Woodpeckers	1/8 in		
Crank Arm	1				Self Made		
Grip	1				Self Made	Cut from 48" wood rod	
Clue Guide							
Wood 2x4 (9" cuts)	1	2.97	2.97	Home Depot	96 in whitewood		
Upper Legs	4				Self Made		
Plywood sheet	1	11.42	11.42	Home Depot	1/10 sheet (cut into 4 pieces)		
Clue Plate	1				Self Made		
Angle Frame Anchor	4	0.64	2.56	Home Depot	item 23-4509		

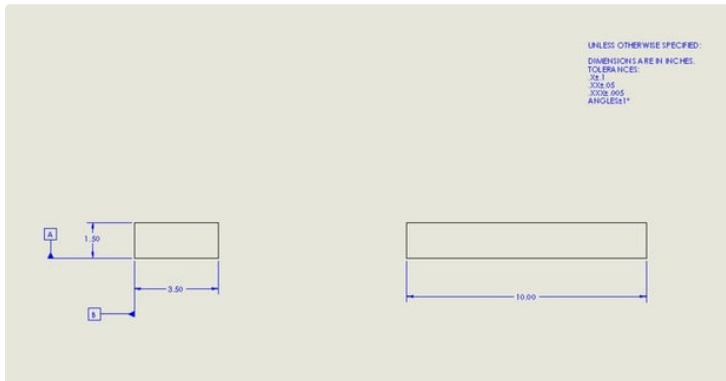
Planet Connection							
Plywood Sheet	1	8.41	8.41	Home Depot	plywood laser cut into 40 rings		
3 Inch Wood Ring	2				Self Made		
4 Inch Wood Ring	2				Self Made		
5 Inch Wood Ring	1				Self Made		
Acrylic Sheet 18" x 24" x 1/4"	1	29.79	29.79	Home Depot			
3 Inch Acrylic Ring	2				Self Made		
4 Inch Acrylic Ring	2				Self Made		
5 Inch Acrylic Ring	1				Self Made		
"Godline" Fishing line	1	13.99	13.99	Amazon	150yd		
Rope	1	10.00	10.00	Amazon			
Planets							
38-45 cm Exercise Ball	2	16.99	33.98	Amazon			
58-65 cm Exercise Ball	2	21.99	43.98	Amazon			
78-85 cm Exercise Ball	1	23.99	23.99	Amazon			
Pulleys							
1 groove	10	8.12	81.20	McMaster	w/ bearing (3742T56)		
2 groove	0	16.08	0.00	McMaster	w/o bearing (3099T23)		
Crimps & tool	1	18.99	18.99	Amazon	Glarks 180Pcs 1.2/1.5/2mm		
	78		411.03				

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## Step 1: Cut 2x4 to Length to Make Lower Legs

Make a cut of the 2x4 wood using a table saw or a miter saw.

Cut Each length of wood to 10 inches in length make sure to compensate for the thickness of the saw you are cutting with.



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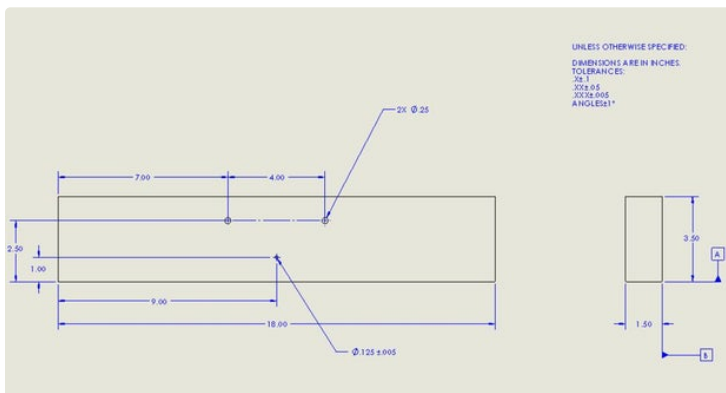
## Step 2: Cut 2x4 to Make Mount Block

This cut of wood requires a table saw or miter saw.

Follow the drawing carefully on this step.

Cut the board to a length of 18 inches

Drill two 1/4 inch holes and one 1/8 inch hole at the specified dimensions in the picture.



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## Step 3: Cut 2x12 for the Base

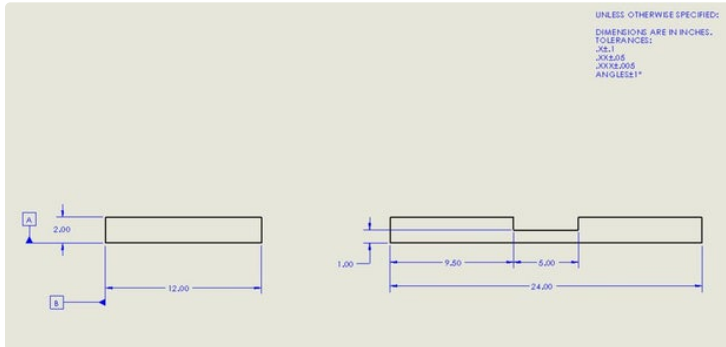
The purpose of this piece of wood is to allow for a weight to rest in the middle of the wood in order for the system to remain grounded during operation.

weight can be placed anywhere along the 2x4 to keep it down but this cut will provide a groove for the weight.

Cut the 2x12 wood to a length of 24 inches using a table saw or miter saw.

One way to approach the cut is to use a table saw aligned with the middle of the board and make multiple passes with the saw until its width is 5 inches.

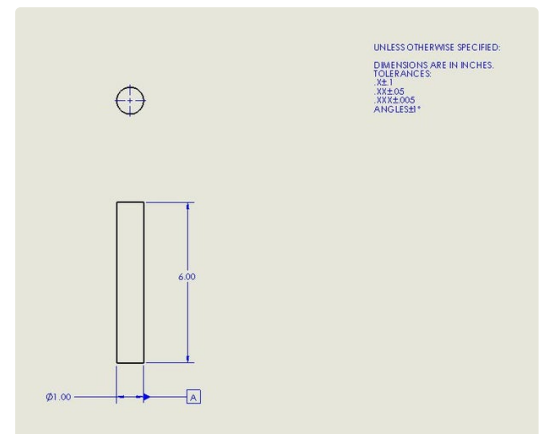
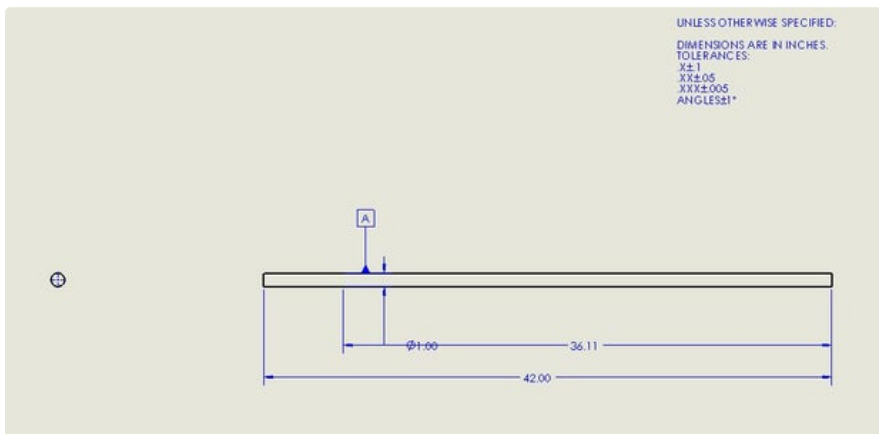
The next cut is more challenging and is optional as



#### Step 4: Make Cut for Shaft and Handle

Using a miter saw cut the 1 inch dowel rod that is 48 inches long to a length of 42 inches, this will serve as the shaft.

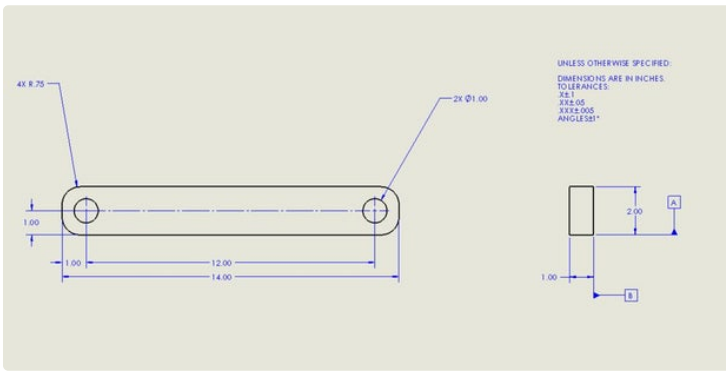
The other 6 inches will be used as the handle for the crank.



#### Step 5: Make Crank Arm

Use scrap 2x4 wood left over and a band saw to make the cuts shown in the picture

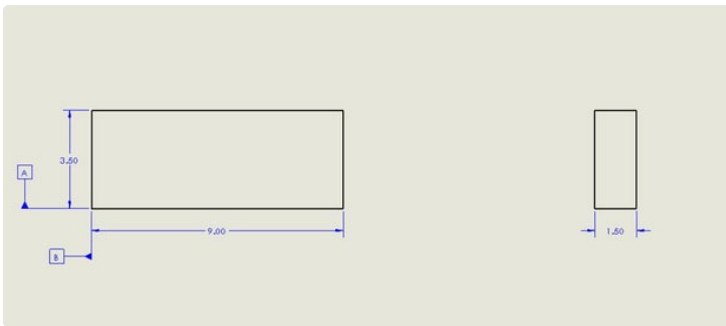
Drill two 1 inch holes as shown and sand as necessary to press fit the shaft and handle in when necessary.



## Step 6: (Optional) Cut 2x4 for Upper Legs for the Clue

This cut will be done with a table saw or miter saw.

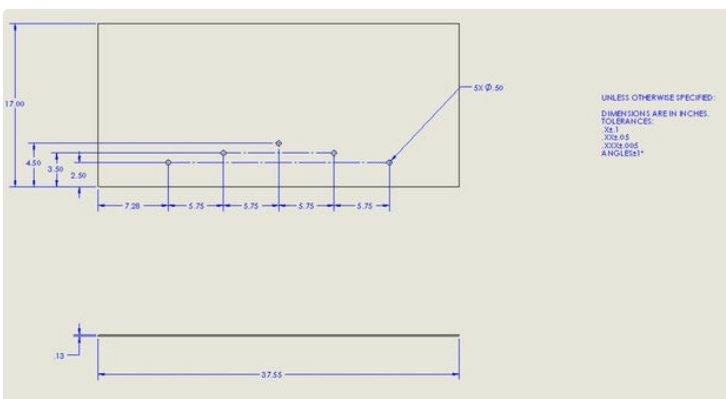
Follow the length of cut in the picture.



## Step 7: (Optional) Cut Plywood Sheet Into Clue Plate and Drill Holes

Follow dimensions shown on the image.

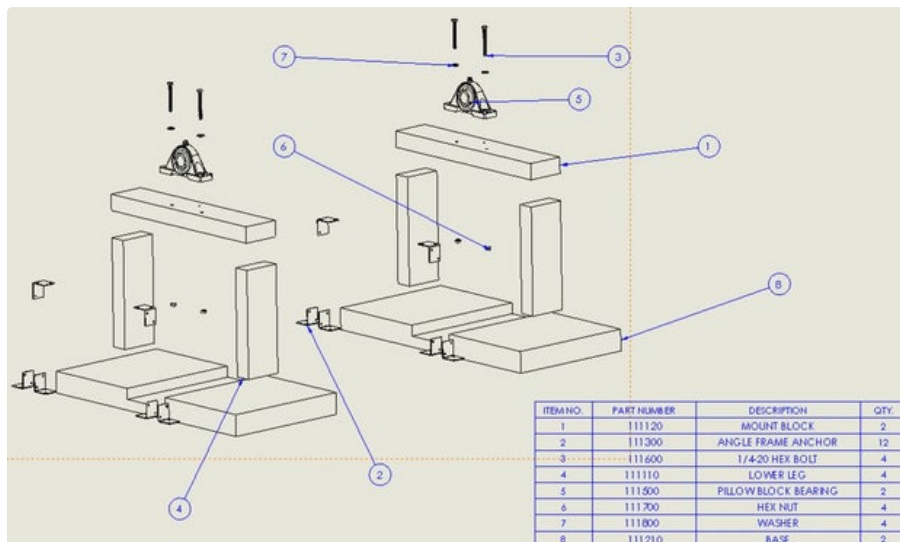
Cut plywood sheet with a table saw to length and drill holes at the respective locations



## Step 8: Assemble Support Structure

With all materials from the material list underneath support structure use them to combine into the orientation shown in the picture.

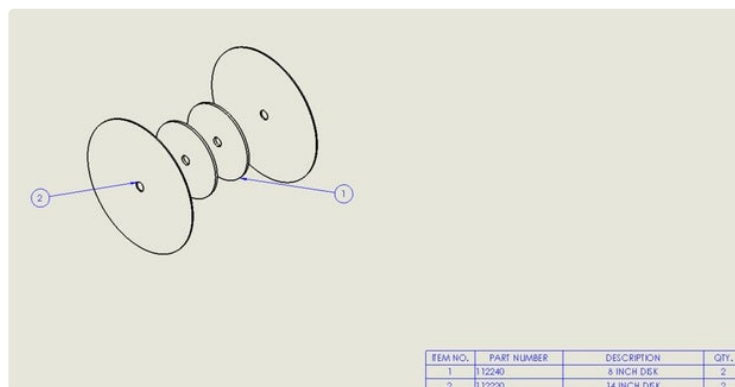
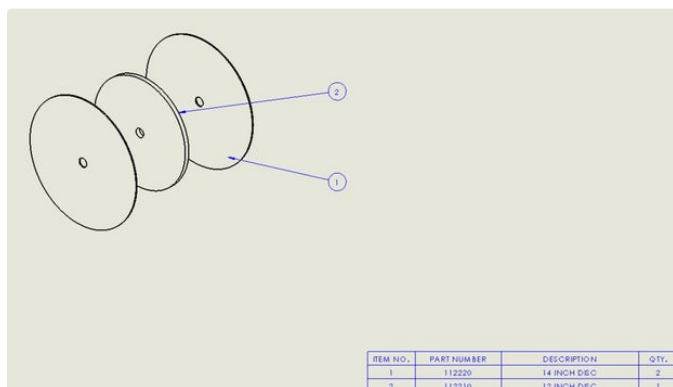
- 1) Place Mount Block upside down and mount each leg to the end with an Angle Frame Anchor and screw in with a power screw
- 2) Flip Legs and mount onto the Base using screws and Angle Frame Anchor
- 3) Mount Pillow Block Bearing through the holes on top and secure with bolts washer and nut.

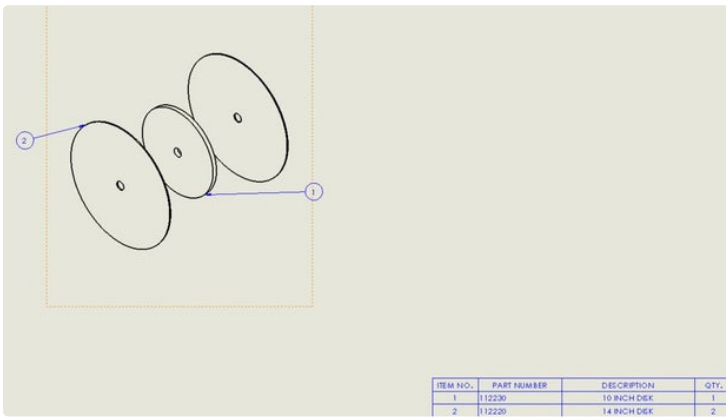


## Step 9: Assemble Disks

Using the 14 inch disks on the outside place the 12 inch disk inside and apply wood glue liberally and allow 12 hours to dry.

Do this with the 10 inch and 8 inch disks too.



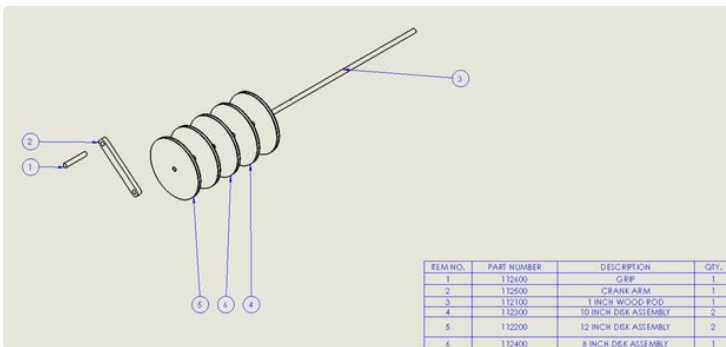


## Step 10: Assemble Shaft

Drill a one inch hole inside of all the dried circular disk assemblies in order to mount with the shaft.

Attach all components as necessary in the orientation shown.

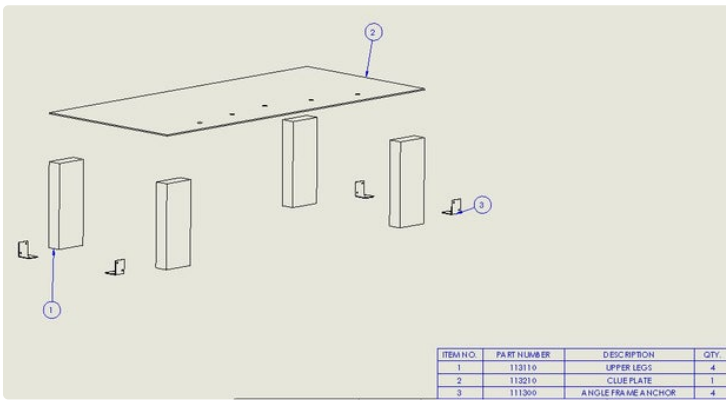
Use sandpaper to sand the wood as needed to press fit the shaft into the wooden disks as necessary.



## Step 11: (Optional) Assemble Clue Guide

Use all the cuts made for the clue guide in the orientation shown and assemble.

Screws and Frame Anchors will be used on this step as well.



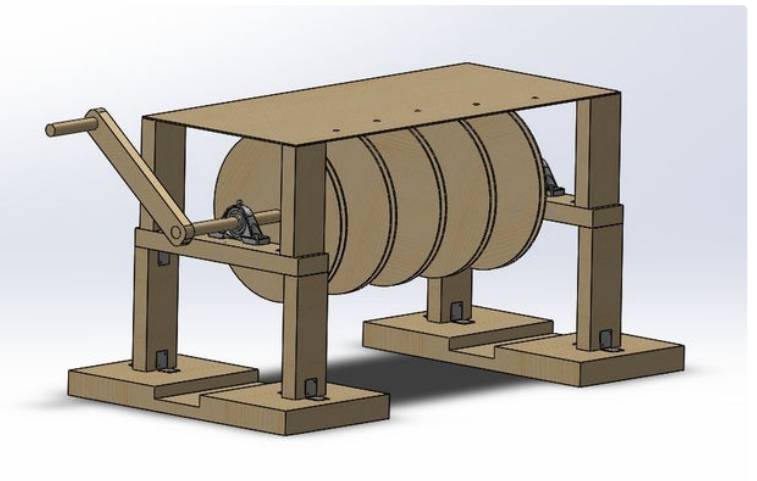
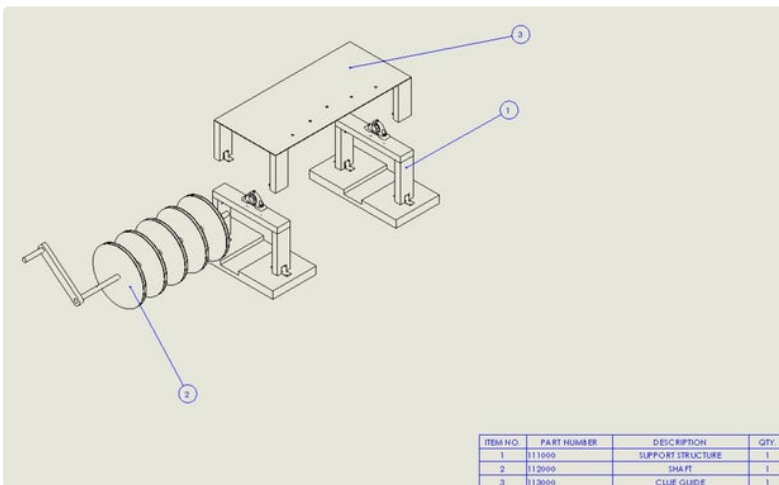
## Step 12: Assemble "Wind-up Rod"

With each sub assembly complete the final assembly can now be finished.

Refer to the picture when assembling.

Mount the shaft inside of the Pillow Block Bearings and tighten with axle wrench.

(Optional) Mount the Clue Guide on the top of the Support Structure once the shaft has been installed.



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## Step 13: Planet Design

### **Pick Planet Sizes**

In our design we utilized 3 different sizes of planets to give more dimension and make it more interesting. We used exercise balls for the base of our planets. Other options could be using beachballs, paper-mache balls (which can be heavy), or create fiber-glass balls (very time consuming and difficult: not recommended but if you're up to it go for it).

### **Decorate Planets**

**GET CREATIVE!** You can paint the balls to be whatever you want. You can create stencils for various patterns and use spray paint to get fun consistent patterns on the ball. You can glue on some cotton balls to give it some texture or add some glitter to give it a little shine. If you are making planets you can create Jupiter or Mars or even create your own planet for fun (this is your solar system after all).

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## Step 14: Connecting Planets

### **Dual Ring Design/Construction**

To attach the planets to the rest of the system, we created two rings that would sit on the top and bottom of each ball and allow you to wrap fishing line around and through the rings to act like a cage and keep the ball in place. The size of these rings can be modified depending on the size of the balls you are working with.

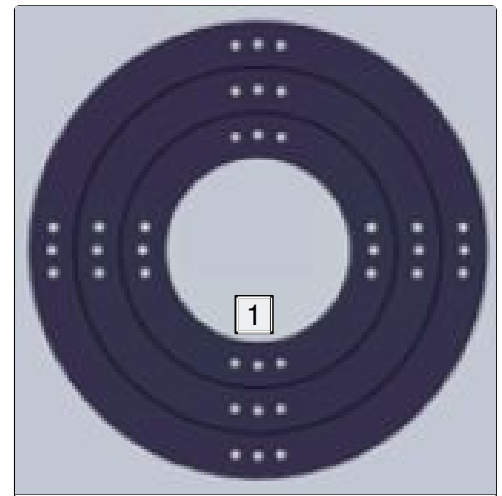
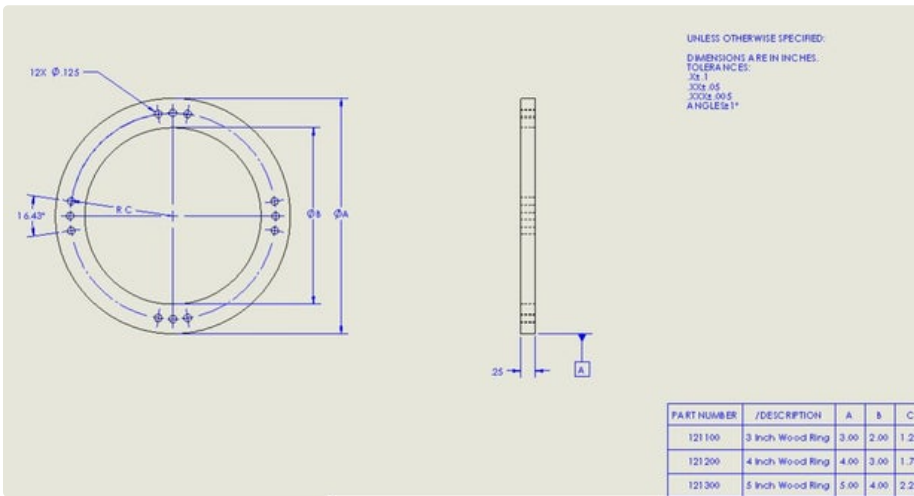
1. **Top Ring:** The top ring has a total of 12 1/8 inch holes spaced in groups of three around the ring. The group of three holes act like a belt or shoelace, letting you feed the string through each and tightening the string without creating slack in any of the other lines.

2. **Bottom Ring:** The bottom ring has 4 1/8 inch holes spaced evenly around the ring.

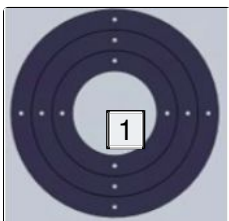
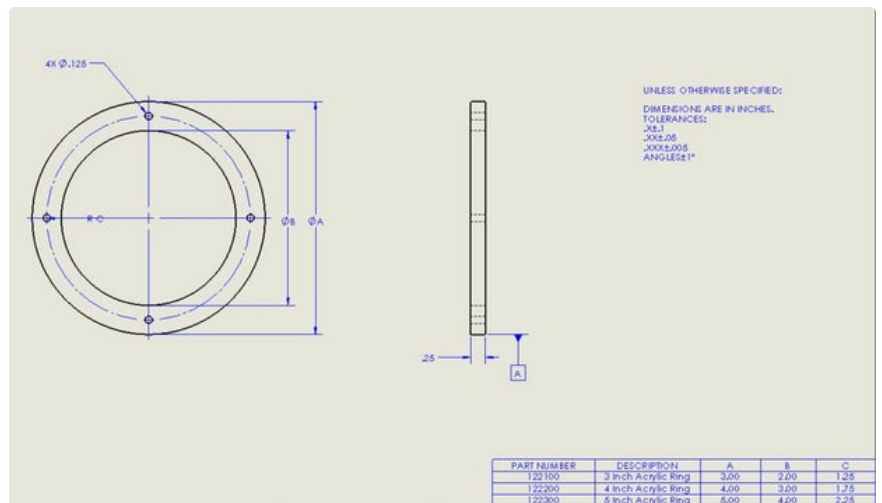
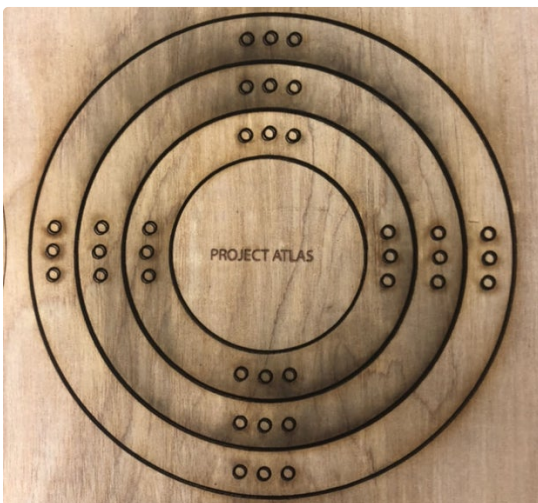
### **Manufacturing**

We used a laser cutter to cut the rings out of 1/2 inch plywood for the top ring and 1/4 inch clear acrylic for the bottom rings. Because we needed three different diameter rings, we made the rings concentric to save material. The rings can also be manufactured using a drill, scroll saw, band saw, sander. Start with a square of wood and trace the ring pattern onto the piece of wood. Next, use the band saw to create the outer diameter of the ring. (If, it's not perfect it's okay, no one will really be looking at the rings.) Next, use a drill to drill a 1 inch hole in the center of the ring. Feed the scroll saw blade through the hole you just drilled, then tighten the blade back into place. Use the scroll saw to create the inner diameter of the ring. After taking the ring out of the scroll saw, use a 1/8 inch drill bit to create the holes around the perimeter of the ring. Finally, sand off any rough edges and repeat the process for the rest of the rings.





1. Top Ring Design



1. Bottom Ring Design

## Step 15: Suspend the System

### Pulley/Clip attachments and spacing

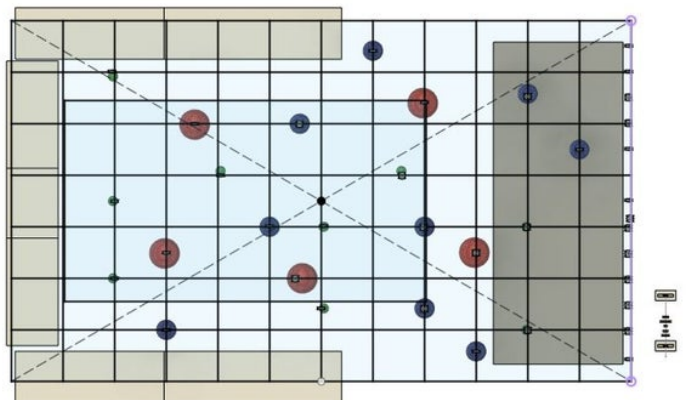
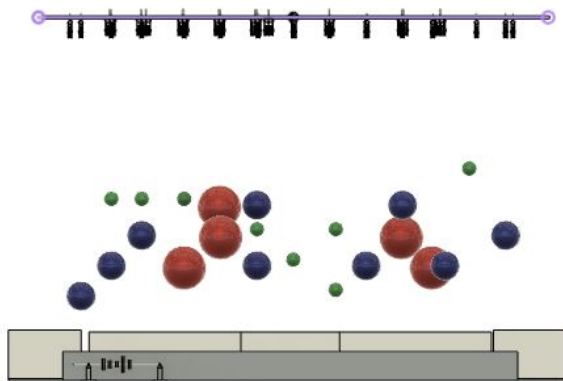
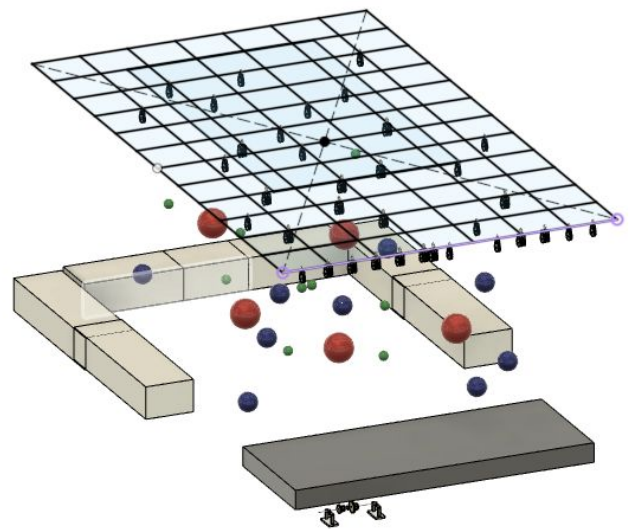
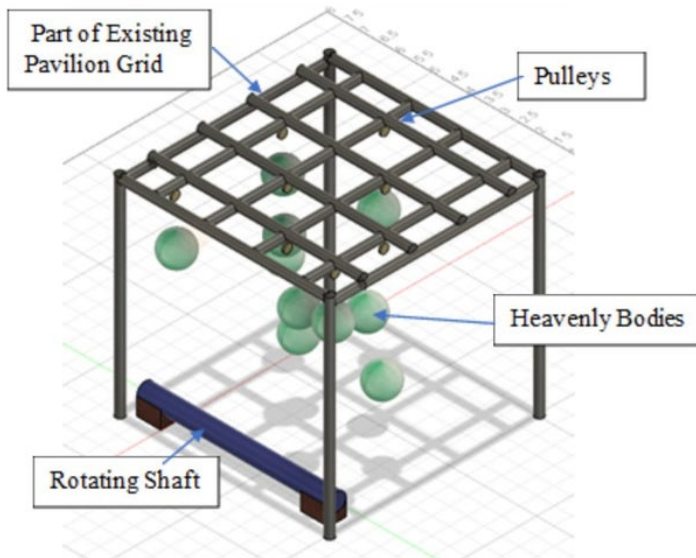
Each planet will have a designated “drop-zone” and you will want these “drop-zones” to be spread out so you can fill the space around you. Directly above each planet will be one pulley and directly above each disc in the Wind-up rod will be another pulley. If there is not a straight line from the disc to the drop-zone you may need another pulley to better guide the string to the planet.

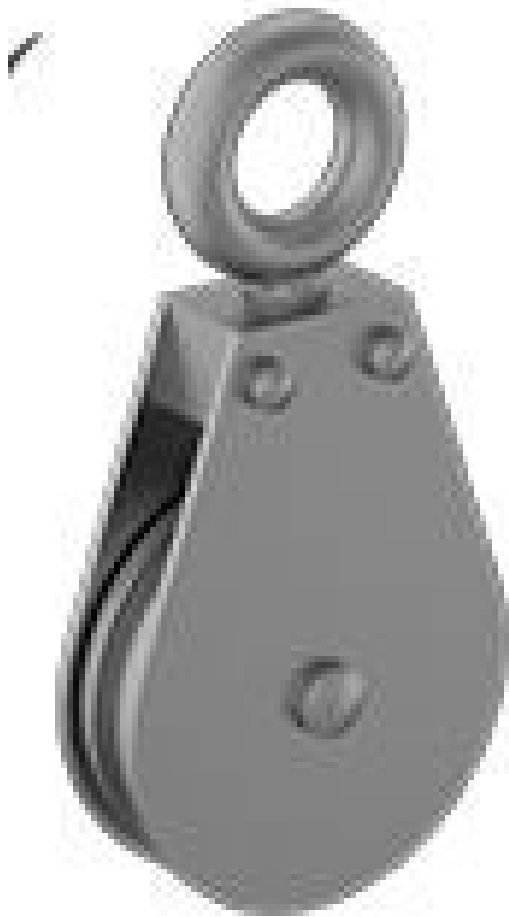
**\*PSA this next part will most-likely be frustrating so have some extra rope on hand and be prepared to redo the process a few times and a few different ways.\*** The easiest

way to attach the planet to the rest of the system would be to first place all of your pulleys on your grid structure (we zip tied the pulleys in place).

Next feed the string that has already been attached to the wind-up rod through the various pulleys landing at the “drop-zone”.

Once the rope is fed through the final pulley string the rope through the loop at the top of the planet and tie it off securely (you can use a crimping tool to crimp the rope around the loop on the planet).





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## Step 16: Running the System

Slowly crank the arm in both clockwise and counterclockwise direction to become familiar with how each rotation effects the system. Once you know which direction is up and down crank the arm and you've got yourself a solar system!! Be aware of how far your planets are moving so you don't accidentally crash into either your grid system or the floor.