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.
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.

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.

Step 3: Cut 2x12 for the Base
Step 4: Make Cut for Shaft and Handle

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

The next cut is more challenging and is optional as weight can be placed anywhere along the 2x4 to keep it down but this cut will provide a groove for the weight.

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.

![Diagram]

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.

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<th>DESCRIPTION</th>
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<td>MOUNT BLOCK</td>
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<td>111000</td>
<td>ANGLE FRAME ANCHOR</td>
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<td>3</td>
<td>111090</td>
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<td>8</td>
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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.
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).

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 ½ inch plywood for the top ring and ¼ 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.
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).
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.