Metal Motion Vehicle DES 310 Fall 2022

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Design Brief

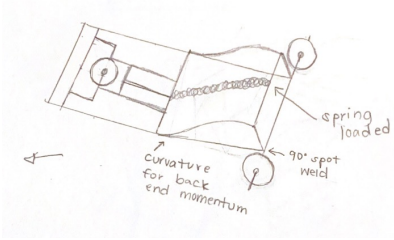
Our assignment was to design and manufacture a 3-wheeled vehicle from steel rod, sheet metal, and inline skate wheels that is primarily powered by gravity.

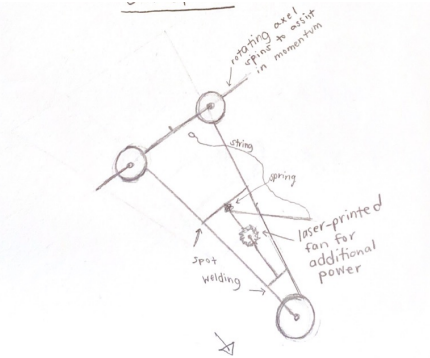
We are evaluated based on the **Distance** it goes, the **Speed** it goes, and the Vehicle's **Control** during it's ride down the ramp of the SFSU Fine Arts Building.

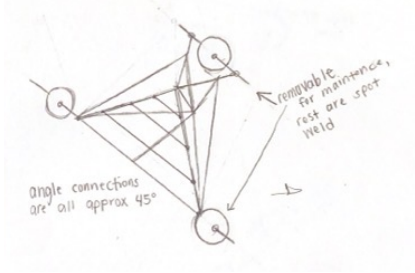
My inspiration was from paper airplanes since I always enjoyed making them and testing how far they could go aerodynamically.

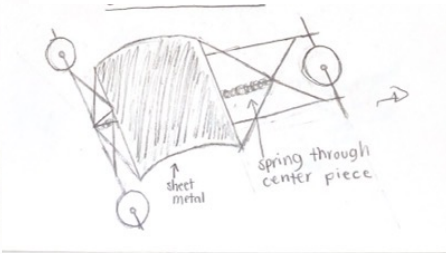
Ideation Sketches

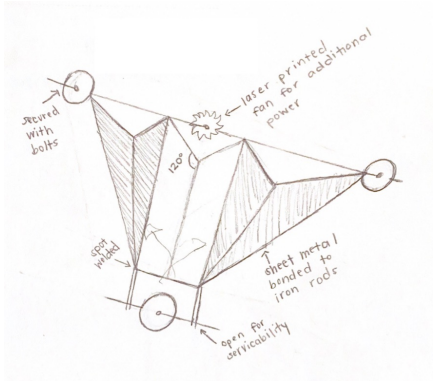
Keeping in mind the idea of an airplane, all angles were examined. Would a kite-shaped vehicle have better transportation since the vehicle is only gravity powered? Ultimately, it was decided that a winged approach would be best for aerodynamic speed and control.



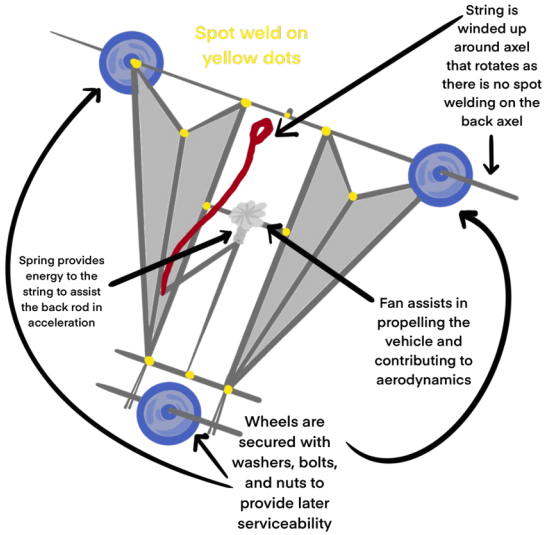




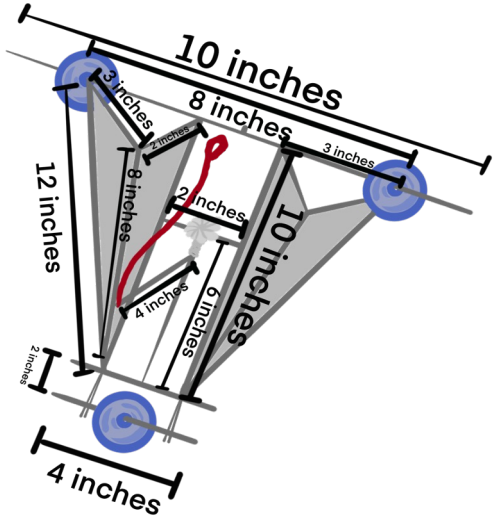




Annotations



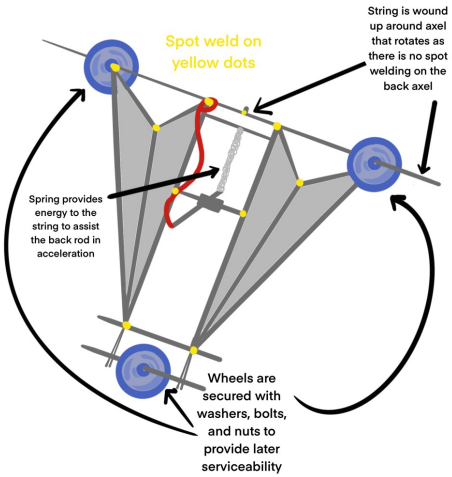
Measurements



Selected Design

Once settling on a shape, detailed sketches were drawn. This was the first iteration.

Annotations



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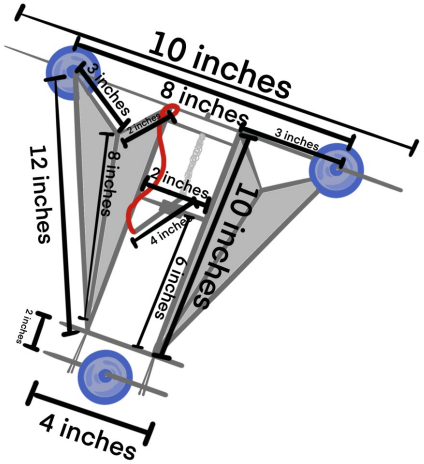
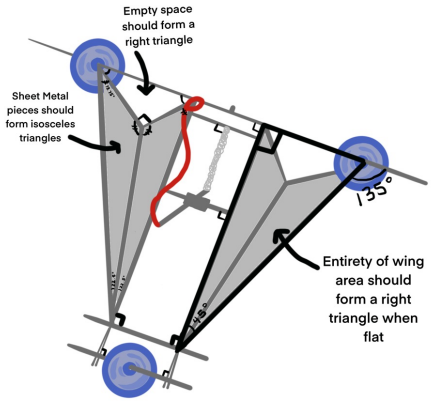


Angles

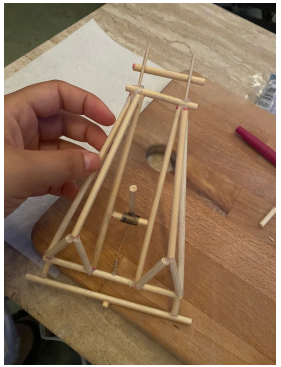


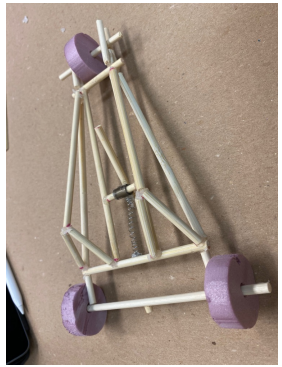
Final Sketch

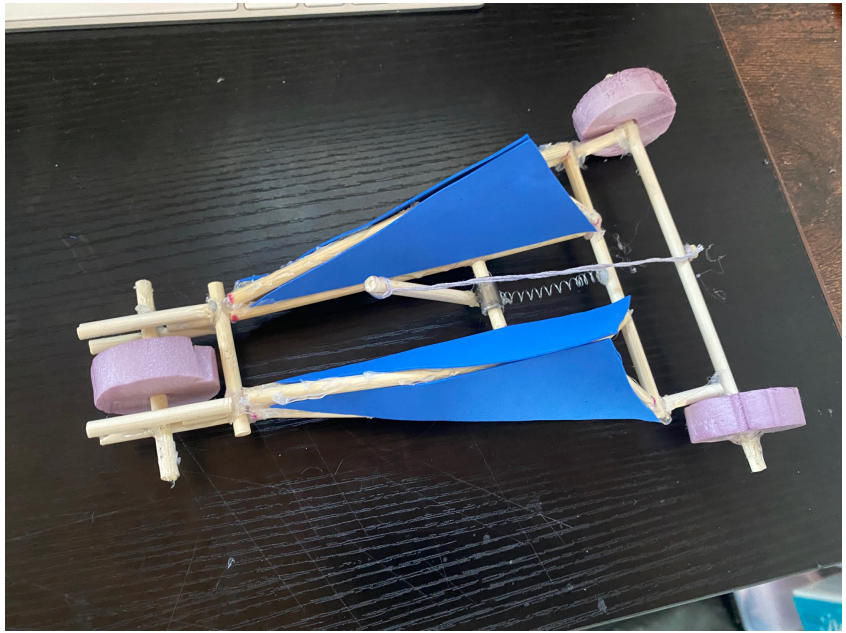
It was decided that a spring and rotating axel would provide more speed than the vehicle alone and that the fan was an unnecessary addition.

Prototyping: Foam Core

Utilizing wooden dowels, foam wheels, a pen tube and spring, yarn, and hot glue, a 50% scaled model was assembled. It was during this process that the realization was made that brackets and additional wheel bearing would be needed so the back axel could freely rotate.



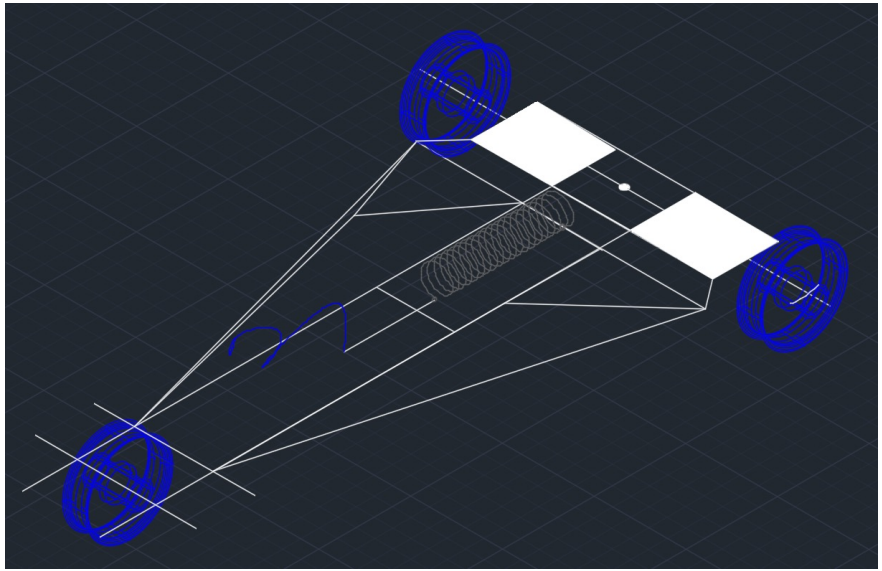




Prototyping: CAD

Utilizing Autodesk's AutoCAD 2023, a 3D rendering was assembled of the full-scale model. Within this, the serviceability of the vehicle was better visualized so that the wheels and bearings could be disassembled and replaced if necessary. As well, the ideal layout of the back axel was mapped out since it was not included in the wooden model.

Download DWG file here via Box.



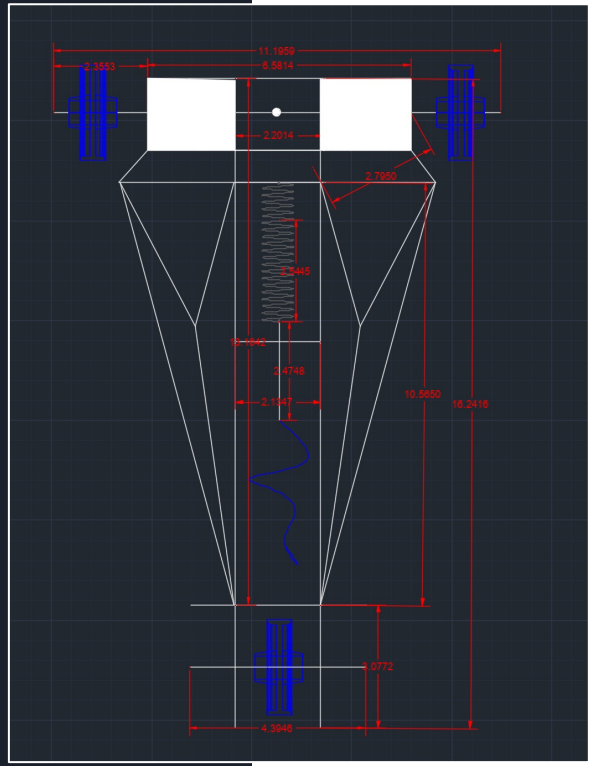
No.	Part No.	Description	Qty	B/M	Manufacturing Process	Reference
1	W3958	Wings, 1/4" round rod, 39 5/8"	2	M	Tread, Cut, Weld	Tools: Die, Breaker, Weld
2	FAH8	Front Axel Holds, 1/4" round rod, 8"	2	M	Bend, Tread, Cut, Weld	Tools: Die, Breaker, Weld
3	FA438	Front Axel, 1/4" round rod, 4 3/8"	1	M	Cut, Tap and Die	Tools: Die, Breaker
4	BA1218	Back Axel, 1/4" round rod, 12 1/8"	1	M	Cut, Tap and Die	Tools: Die, Breaker
5	FCB2558	Front, Center, and Back Support, 1/4" round rod, 25 5/8"	1	M	Cut, Tap, Die, Weld	Tools: Die, Breake, Weld, etc.
6	SN1420	Standard Nut, 1/4"x20, steel	10	B	Tread Pitch	Tools: 1/4" rod, die parts (add part no)
7	W14	Washers, 1/4" steel	10	B	Tread Pitch	Tools: 1/4" rod, die parts (add part no)
8	SR20	String Rope, 20"	1	B	Cut to speficied length and tie	Tools: Scissors
9	SBB38	Steel 3/8" brackets for barrings	2	B	Installed to back with screws	Tools: Screwed to vehicle
10	SM118	Sheet Metal 1/8" thick, 1'x18"	2	B	Cut to specified dimension	Tools: Shears
11	W13	Wheels 1" thickness, 3" diameter	3	B	Installed to Axels with Washers and Lock Nuts	Tools: Wrench
12	GSN13414	Galvanized Steel Nipple 1 3/4" long by 1/4" opening	1	B	Inserted in center support	Tools: Inserted Metal Rod inside
13	SP1	Spring	1	B	Welded	Tools: MIG Welding
14	WB6	Wheel Barring	6	B	Hammered In	2 per wheel and one per bracket
15	S6321	Screws 6-32 1"	4	B	Screwed In	Screwed to part SP14
16	SN632	Standard Nut 6-32	4	B	Screwed In	Screwed to part SP14
17	LN1420	Lock Nut 1/4"x20	4	B	Screwed In	Screwed to axel BA1218
18	SP14	Steel Plates 1/4" with 2 3/8" drill holes	2	M	Drill Press, Metal Saw	Used to install brackets with wheel barrings
19	V6	Vinyl Flame Sticker	2	M	Die Cut	Utilized home tools to create embellishments

Bill of Materials

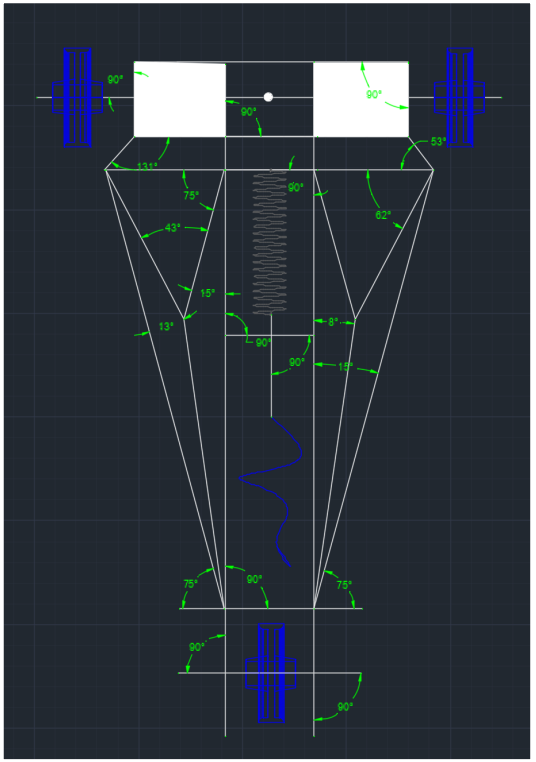
Here is the bill of materials used along with the manufacturing process for each part.

Schematics: CAD and Assembly

Download DWG file here via Box.



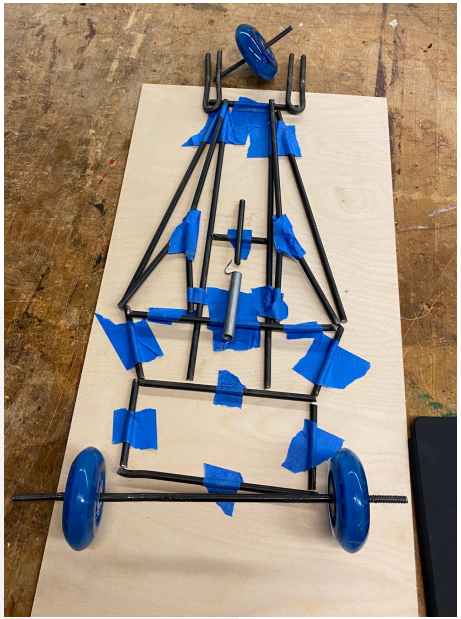
Measurements

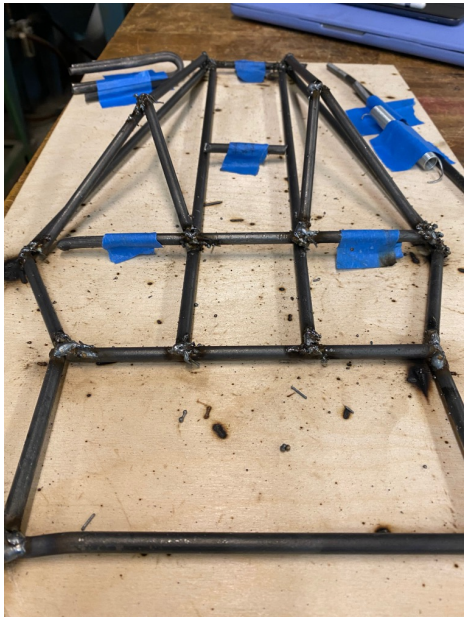


Angles

Process: Assembly

The initial welding was not very secure and was easily falling apart. Professor Jalali helped to reconstruct the structure welding and it was much more secure after this. The photos are of the initial welding after layout and assembly.



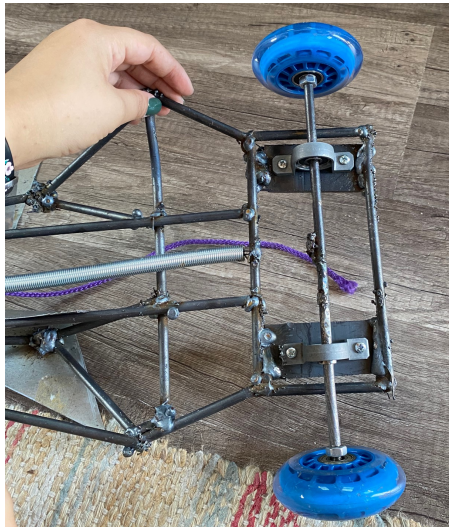


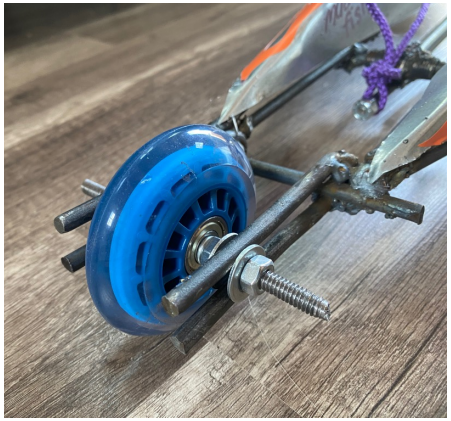
Welding Process

Here is a video of the welding process (MIG) used.
Click here if in PDF format.

Process: Packaging and Maintenance

The packaging process involved screwing in the wheels to the axels and the brackets to the back support. Making these components replaceable by not utilizing fusion allows for future maintenance on the wheels and wheel bearings, as well as the nuts, washers, and screws if necessary without completely tearing apart the vehicle.





Labelled Components

A – Wheels

B – Back Bracket Housing

C – Rear Axel

D – Spring

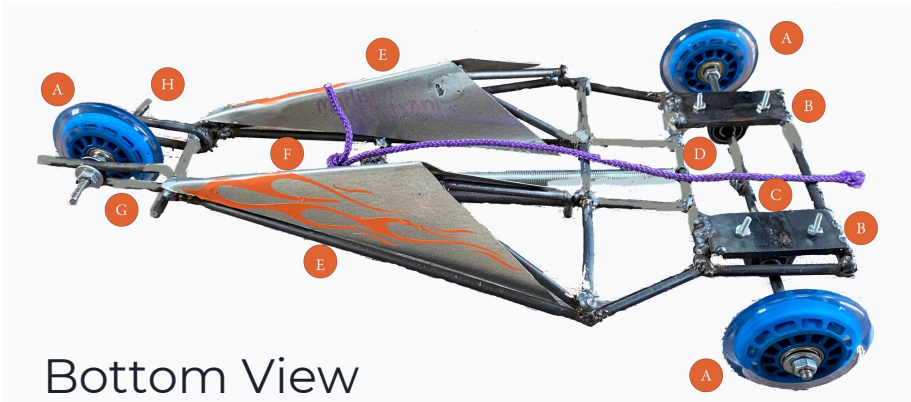
E – Sheet Metal Wings and Support

F – Rope and Center Housing

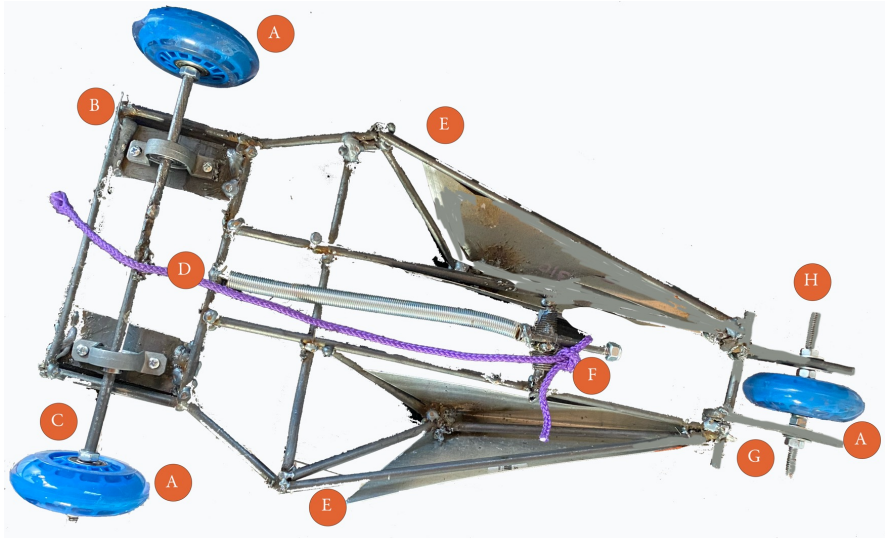
G – Front Axel Support

H – Front Axel

Top View



Bottom View



Process: Manual

Reference Bill of Materials (Page 8) for additional details.

1. Measure, mark, and cut ¼” round rods to specified dimensions. Tap and die axel pieces on ends for serviceability. Bend front axel holds to u-shaped pieces.

2. Measure, mark, and cut sheet metal to specified dimensions. Bend to create triangle shaped wings.

3. Measure, mark, and saw steel plates to specified dimensions. Mark holes for drill press and operate with 3/8” hole. Grind any pieces to prepare for welding.

4. Layout all pieces on wood scrap and drill to board in desired welding position. Weld all flat pieces. Add the triangle wings and u-shaped front axel holds with magnets after unscrewing the main body from the scrap wood. Add bent sheet metal on top of triangle wings and steel plates on back axel holding. Insert pipe in center support and weld center support to body of the model. Weld holding rod to free-spinning pipe. Welding spring to center of body.

5. Insert wheel bearings into wheels and back brackets. Grind down any welds that need to be cleaned up.

6. After welding, assemble the serviceable parts (front axel, brackets, back axel) with nuts, screws, and bolts.

7. Tie string to center holding rod. Roll it around the back axel and release to test!

Product Photos

Top: Final project from side

Middle Left: Back axel housing

Middle Right: Front axel housing

Bottom Left: Shot of underneath

Bottom Right: Back housing from top