Mechanical Engineering 2020-2021

Bellevue, Washington

Team ID: #1098-1

By: Aayush Rao, Neel Gowda, and Yudhish Kumar

Technology Student Association (TSA)

Table of Contents

Identification and Explanation of Engineering Design Process

Step 1: Identify the Problem and Constraints

Our problem for this project was creating a Rube Goldberg machine with four separate subsystems. Each subsystem was to be only a square foot and use a specific amount of the six different simple machines. After viewing the TSA website and the Virtual Guide, the constraints we identified were time, quality, quantity, and space.

Time: Our machine had to reset in three minutes.

Quantity: Our machine required two simple machines repeated twice in the first three subsystems, and all six in our fourth subsystem.

Space: Our machine had to fit within a 12” x 12” x 18” space.

Quality: Our machine had to have been optimized for use and complete a given task with no outside help after an initial push.

Step 2: Research

We researched implementation strategies for the six separate simple machines and for different ideas for our Rube Goldberg device on YouTube.

Step 3: Concept Sketches and Ideas

We used a 3D modelling software called Blender to visualize our solutions. In Blender, we took our paper plan and visualized Our first deadline was concept sketches. We used a 3D modeling software, Blender, to visualize our ideas. In Blender, we took our paper plan and implemented it in the software, adding and modifying to our initial ideas as we saw fit.

Step 4: Choose the Optimal Solution

After sketching basic ideas on paper, our team decided to use the most efficient solution per the constraints. We added it on Blender as an extra step to insure that was the correct solution and decided on to keep thar after other options did not appear to work.

Step 5: Develop a Prototype

Our team split the work of subsystems into four different sections, and each team member used items around their house to create and assess a prototype of each subsystem.

Step 6: Test and Revise

For multiple subsystems, our design was too large to fit within the required dimensions, and we were forced to change our solution multiple times in order to meet our constraints. After revision, our mechanical device fit into the required dimensions. However, the subsystem didn't function for other reasons, and we needed to alter our design until our Rube Goldberg machine met all of the requirements and properly functioned.

Step 7: Communicate Results

We communicated our results through this portfolio with many images of each subsystem. Please reference page 8.

Explanation of the Usage of the Six Simple Machines

In Subsystem 1 We Used (Reference Page 8 for Images):

1. Inclined Planes
    a. We used two inclined planes in our first subsystem. The first one was built for a car to travel on, and the second was built for our second Wheel and Axle to travel through.
2. Wheel and Axles
    a. We also used two wheel and axles in our first subsystem. Our first one was a car, which travelled down an inclined plane, and our second one was simply two wheels connected with a rod travelling down another inclined plane.

In Subsystem 2 We Used:

1. Wedges
    a. The teammate responsible for this subsystem hasn't responded in time for submission, and once another teammate can finish this section, we will update the portfolio.
2. Levers
    a. The teammate responsible for this subsystem hasn't responded in time for submission, and once another teammate can finish this section, we will update the portfolio.

In Subsystem 3 We Used (Reference Page 10 for Images):

1. Screws
    a. We used two screws in our third subsystem. The first screw was meant to carry a marble and drop it into a pulley, and the second screw completed a similar task, dropping a marble into an inclined plane instead.
2. Pulleys
    a. Similarly, we used two pulleys in our third subsystem. The first pulley was meant to set a marble rolling down an inclined plane, and the second pulley set a marble down a screw.

In Subsystem 4 We Used (Reference Page 12 for Images):

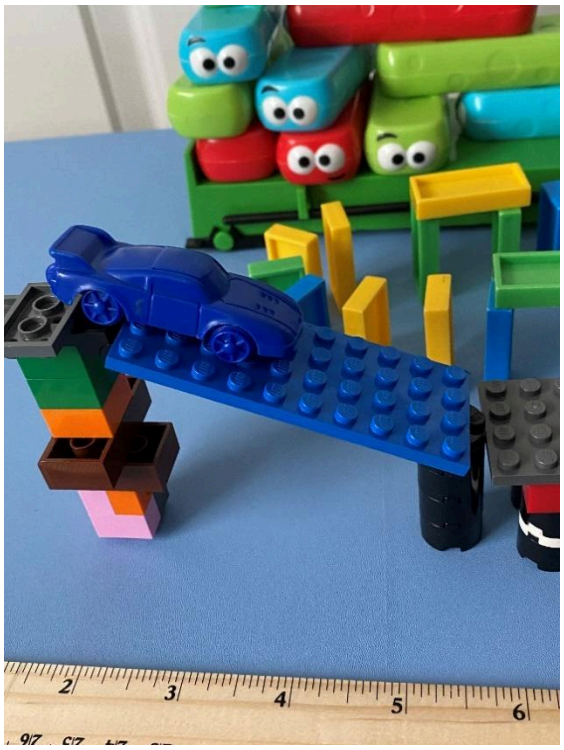
1. Pulley
    a. We used a pulley near the end of the last subsystem. It cam right after the screw, and is knocks the wheel and axle (the car) down a ramp. It is two plastic cups around a circular object.
2. Screw
    a. We used a paper screw for subsystem 4. It was bent in the shape of a rectangular screw and a marble will roll down it. The marble will then fall into the pulley.
3. Wheel and Axle
    a. The wheel and axle in this subsystem was the car. The Pulley hit a Lego ramp up and the car rolls down and hits a domino “tower”.
4. Inclined Plane

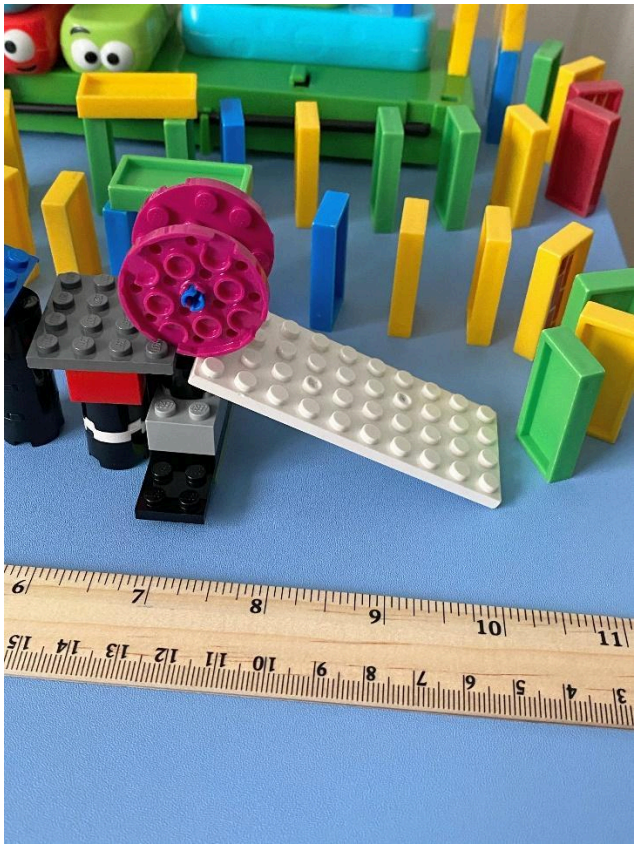
   a. The inclined plane we used was the green ramp from Yudhish's domino set. The marble rolled down it and hits some dominos knocking another marble into the screw. The inclined plane was not very steep.

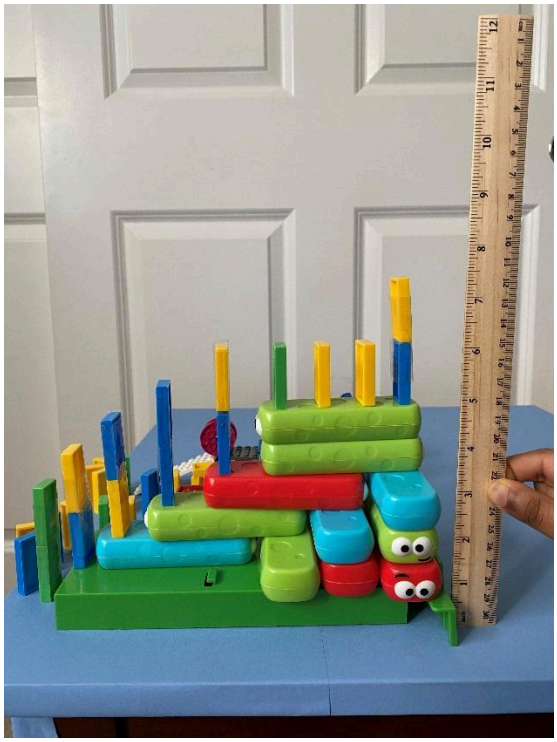
5. Lever
   a. The lever in this subsystem was part of the green inclined plane thing. It is in the bottom left corner. When the domino hits the lever, it hits a long plastic stick up, knocking the marble down the inclined plane.

6. Wedge
   a. The wedge was what we used to start the subsystem. The wedge separated 2 balls and one of them hit dominos and continued to the lever. The wedge was made of Legos so that it would be very light and would be able to be pushed by the third subsystem's ending.

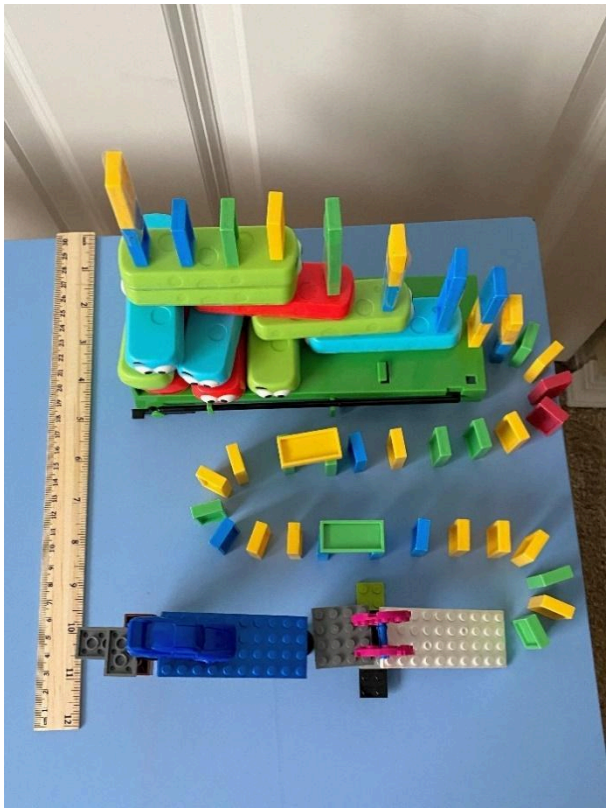
Subsystem 1

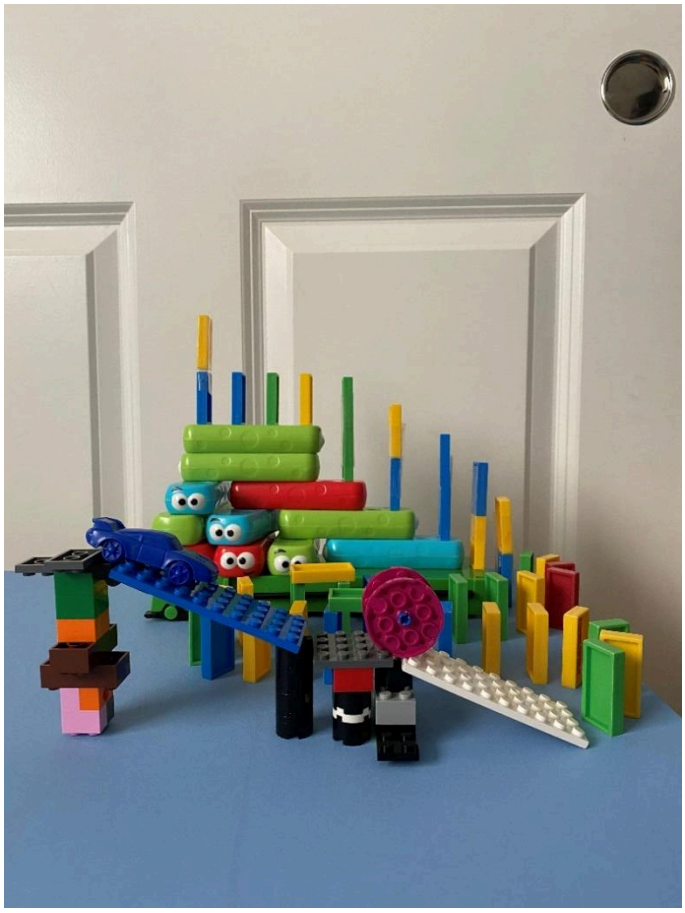




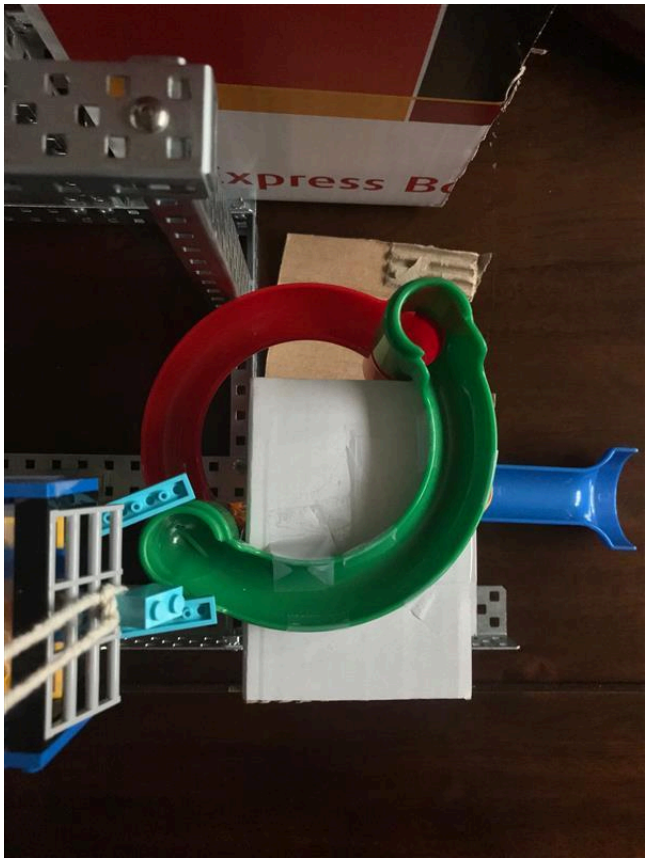


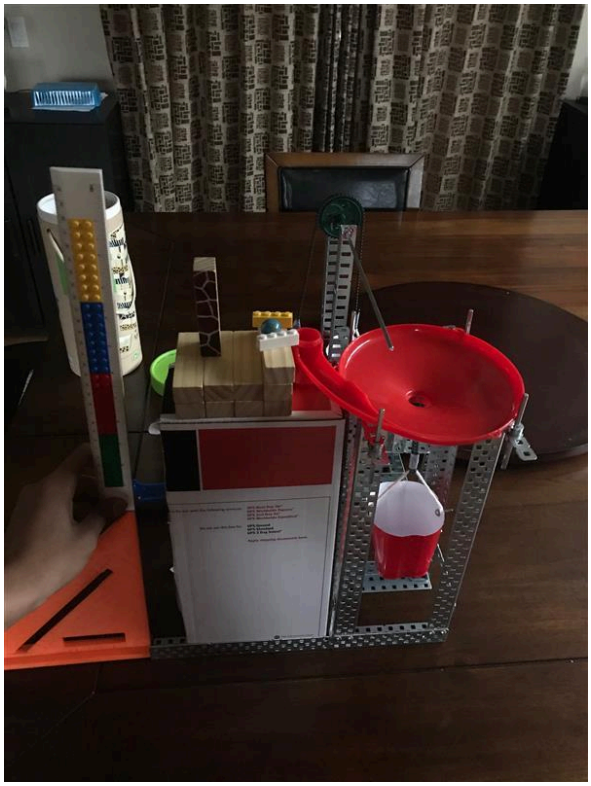
11

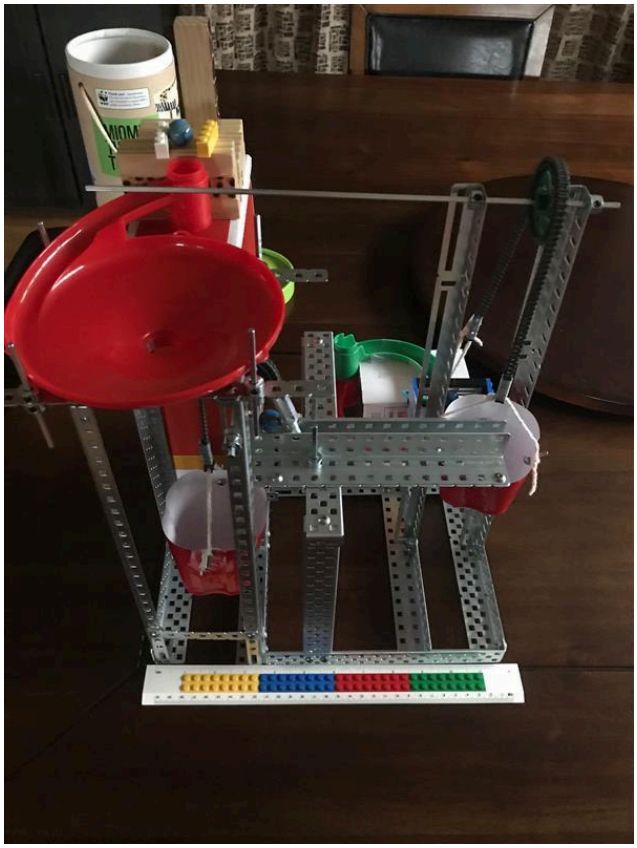




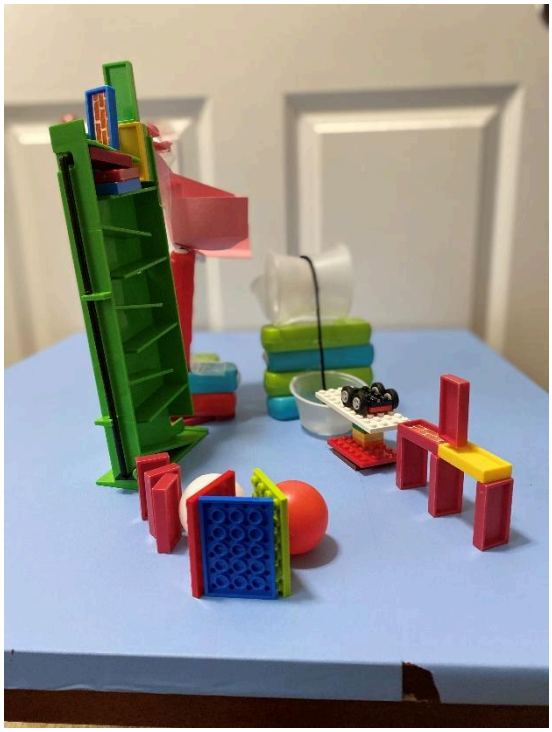
Subsystem 3

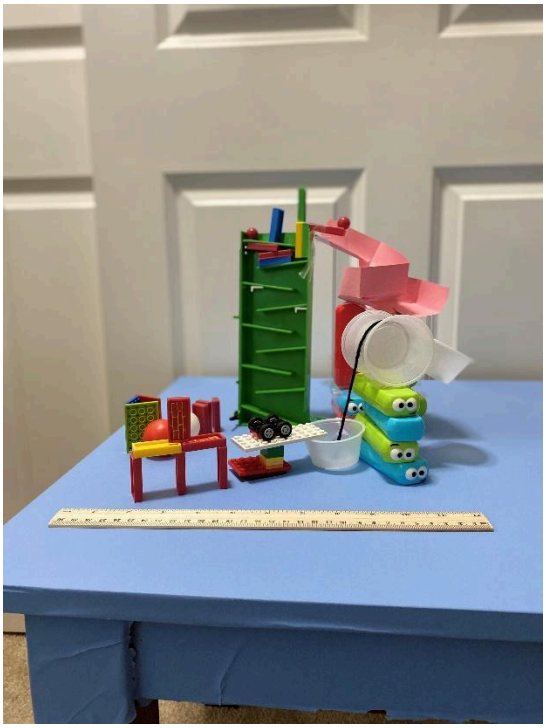


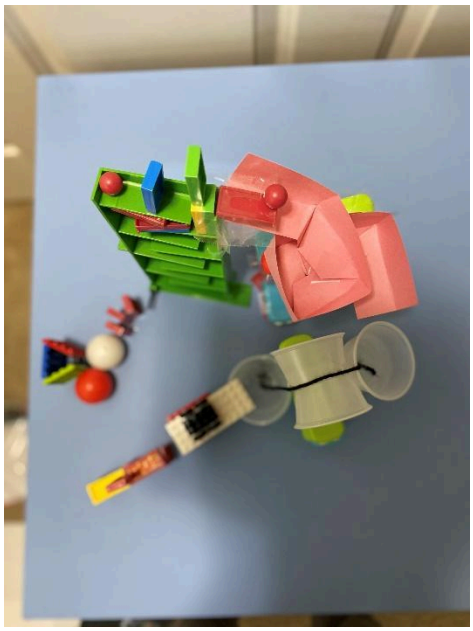


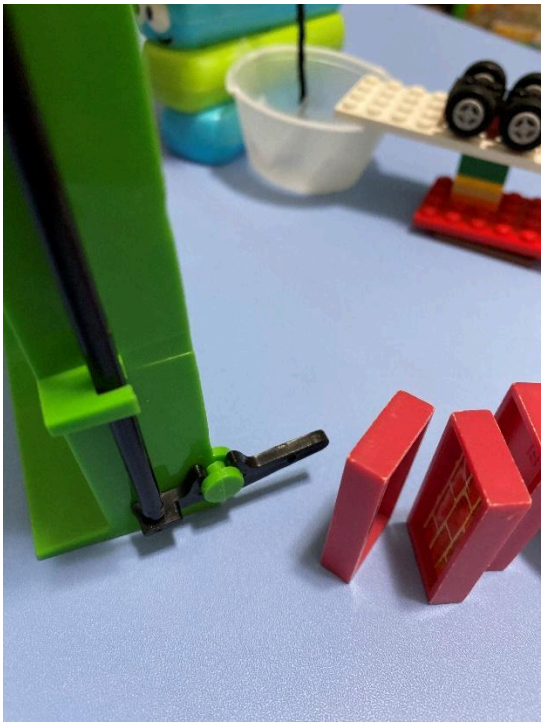


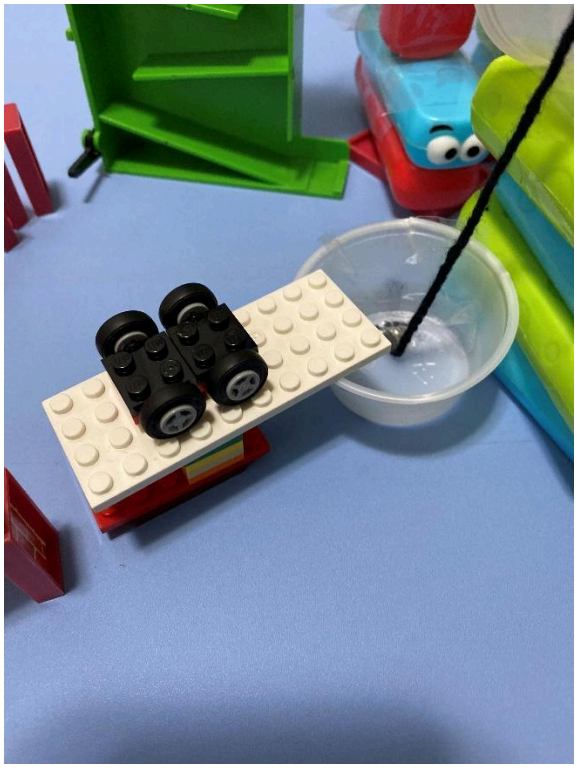
Subsystem 4

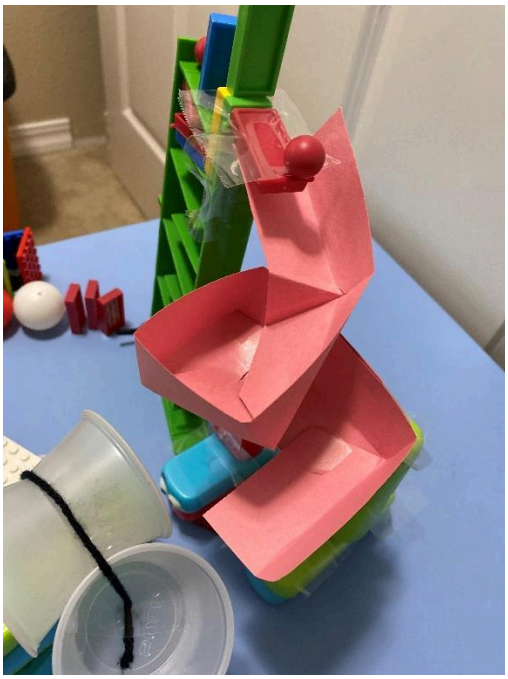












Bill of Materials

- Cardboard
- Chain
- Collar
- Jenga Blocks
- Legos
- Marble Run Curved Inclined Plane
- Marble Run Screw
- Marbles
- Paper
- Pieces from “The Bug Game”
- Pieces from a Domino Rally Set
- Plastic Balls
- Plastic Cups
- String
- Tape
- Vex Robotics C Channel
- Vex Robotics Gears
- Vex Robotics Hex Sided Screw
- Vex Robotics Keps Nut
- Vex Robotics L Channel
- Vex Robotics Plates

Plan of Work Log

TECHNOLOGY STUDENT ASSOCIATION PLAN OF WORK LOG				
Date	**Task**	**Time involved**	**Team member responsible** (student initials)	**Comments**
1. 12/26/2020	Drafting	1 hour	A.R.	Began drafting and sketching the machine.
2. 1/5/2021	Almost Done	1 hour	Y.K.	Finished initial drafts for concept sketches.
3. 1/8/2021	Finalizing/Submitting	1 hour	A.R.	We finished concept sketches and submitted them.
4. 1/11/2021	Fixing entry issues	40 minutes	N.G.	File wouldn't open; we submitted differently.
5. 1/19/2021	Review and Portfolio	30 minutes	A.R.	We reviewed feedback and started portfolio.
6. 2/3/2021	Discussion	30 minutes	Y.K.	Figure out when to meet up at Spiritridge park.

Advisor signature Hope Isett

Works Cited

Ibarra, Ricardo. “Mechanical Engineering.” *Washington Technology Student Association*, Washington Technology Student Association, 13 Feb. 2021, www.washingtontsa.org/middle-school-events/mechanical-engineering.

Themes & Problems, Washington Technology Student Association , 2020, tsaweb.org/competitions-programs/tsa/themes-problems.