

Team Zip-It

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Design Brief

Client: Undercover Individuals Living in the Compound

Problem Statement: It's too difficult to zip up a backpack by hand. It requires far too much effort, and it needs to be a simpler and easier process.

Design Statement: We will design, build, and test a machine that will be able to zip up a backpack with a single human input.

Constraints:

- 6 days
- Fischer Tek, VEX, and other approved parts
- Only one outlet for human input of effort force
- Product must be composed of at least four different simple machines

Team Deliverables:

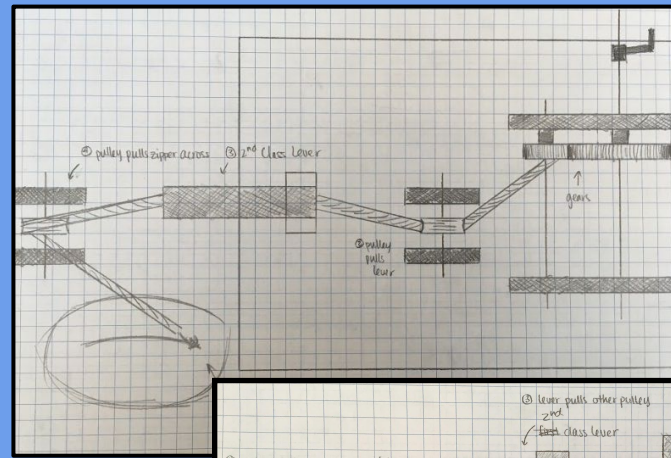
- Prototype
- Online report

Individual Deliverables:

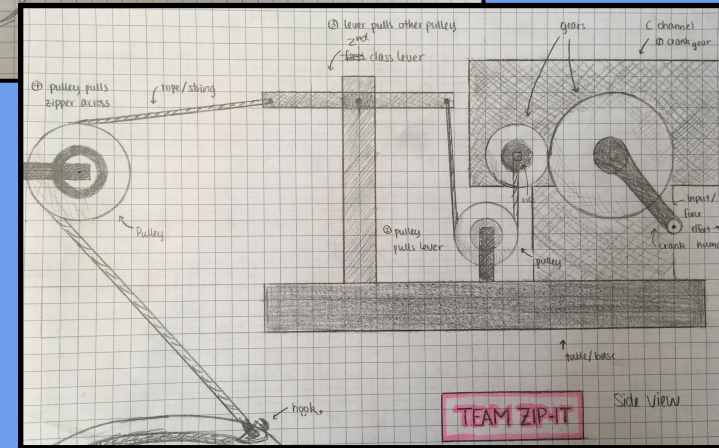
- Two brainstorming sketches
- Project Log of specific tasks completed each day
- Calculations of mechanical advantage for the final design
- Conclusion Questions

Design Proposal

Description: The system starts on the right with a single human input of turning the axle connected to a simple gear system of two gears.



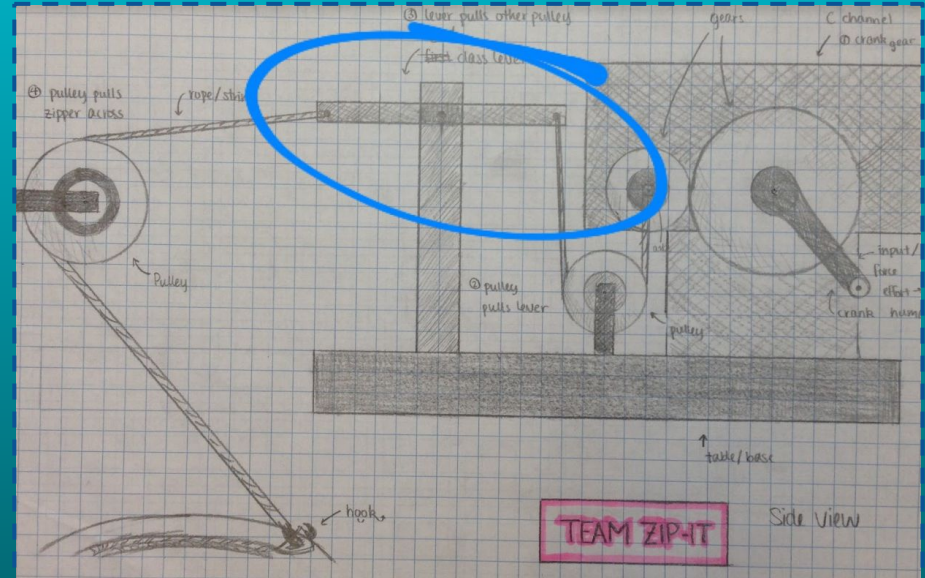
Top View



Side View

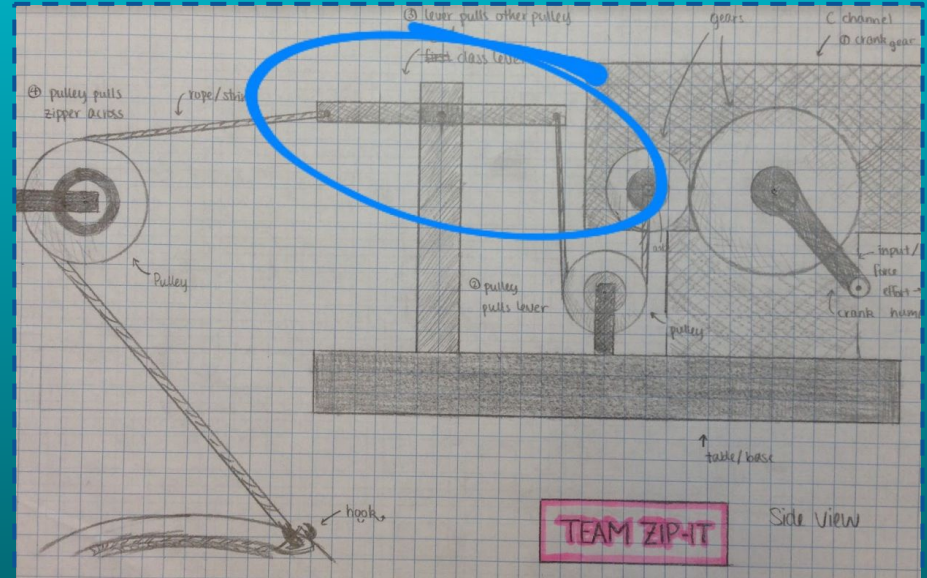
Prototype Modification #1

Our first modification was to change the first class lever to a third class lever, because we thought that a third class lever would have more strength than a first class lever.



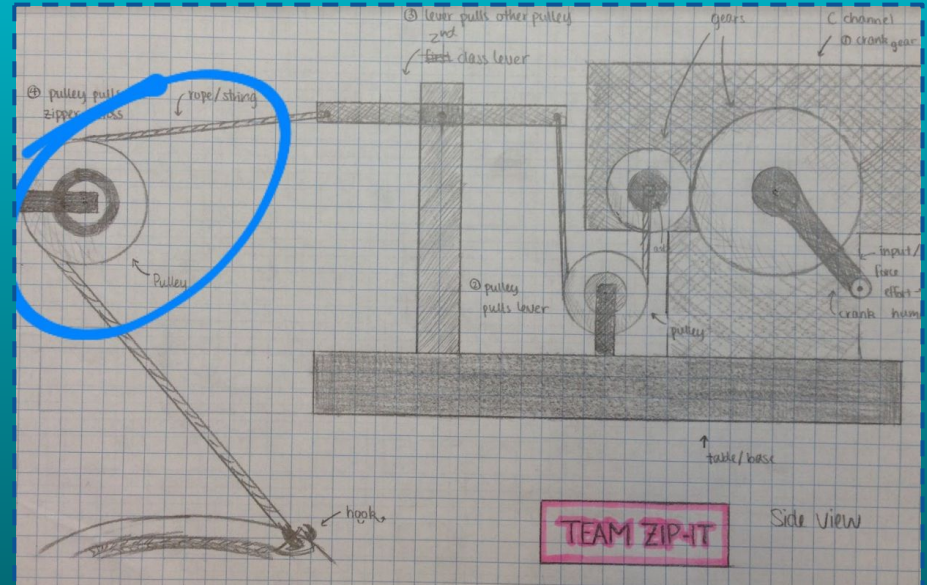
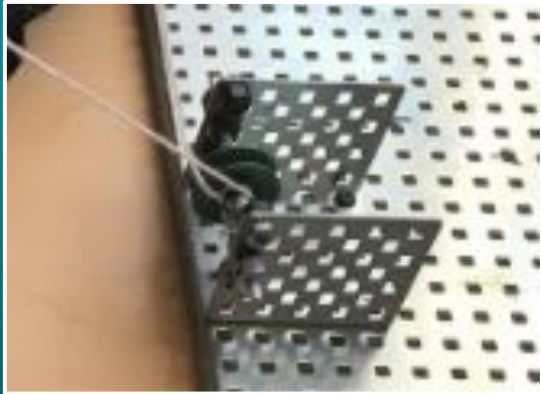
Prototype Modification #2

Our second modification was to change the third class lever back to a first class lever, because the C-channel that made up the lever was too heavy for the string to pull, and the lever did not move at all.



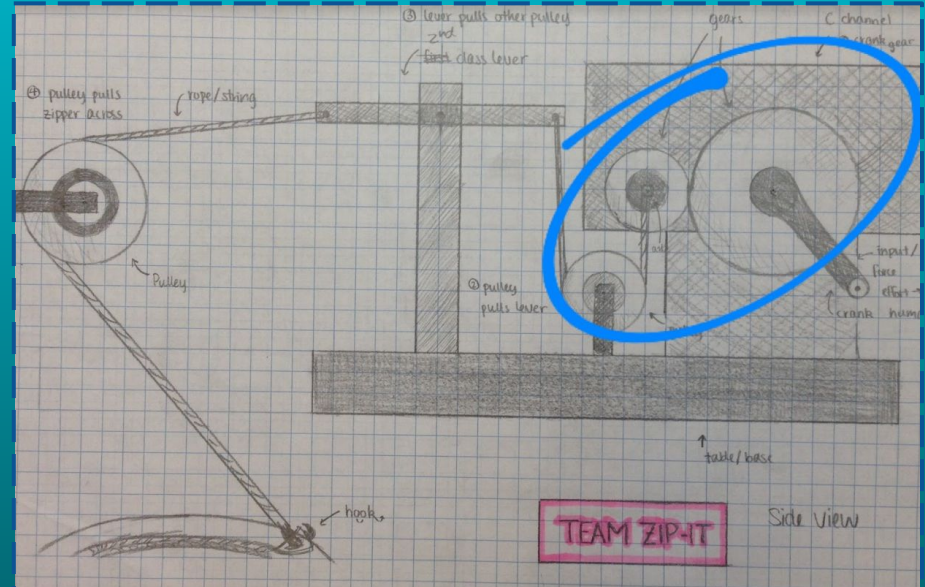
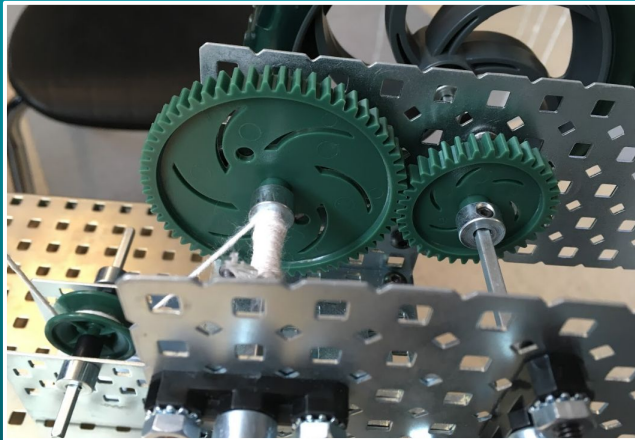
Prototype Modification #3

Our third modification was changing the pulley from being mounted on a wall/C-channel, to being mounted on a second base, and putting it on the very edge so that the metal would not interfere with the string being pulled at all.



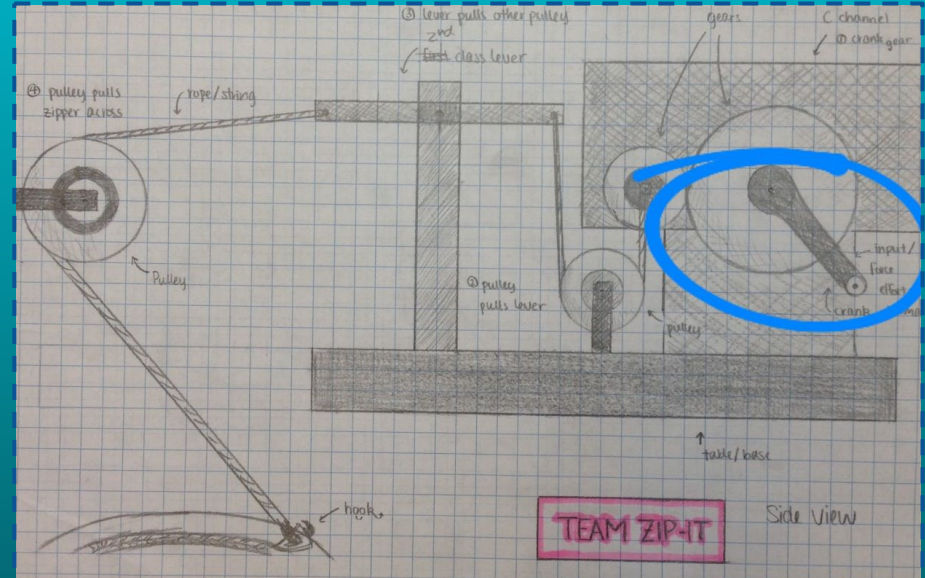
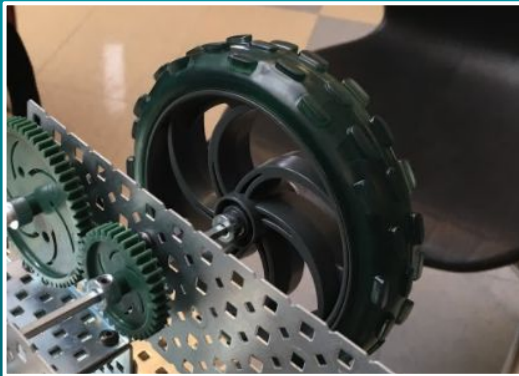
Prototype Modification #4

Our fourth modification was changing the order of the gears: instead of the small gear being first, we put the bigger gear first. This way, there would be more torque, since in this machine, torque is more important than speed.



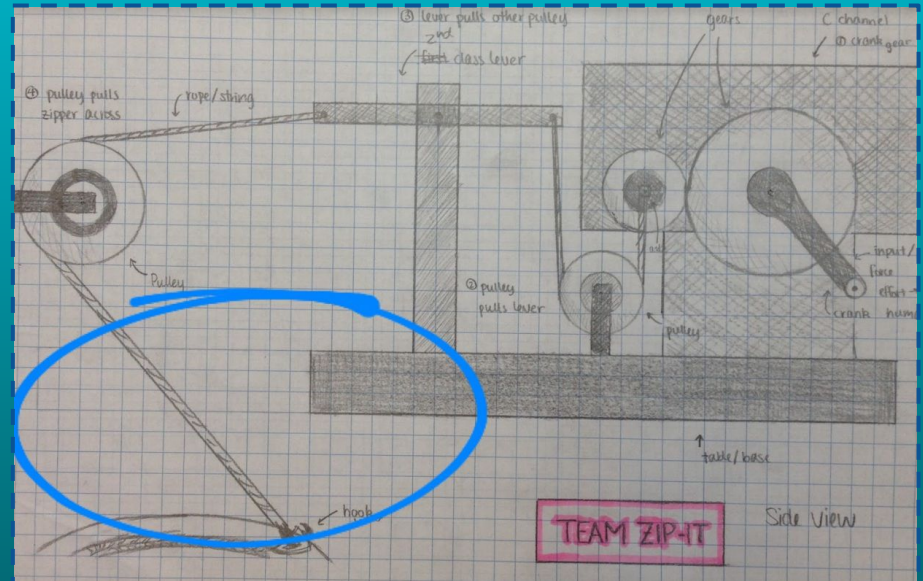
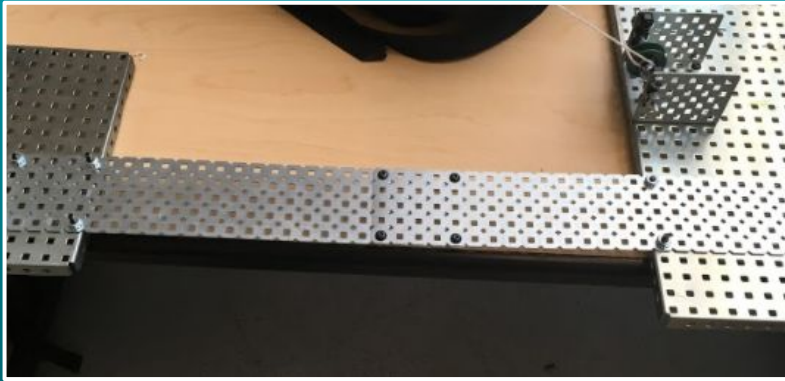
Prototype Modification #5

Our fifth modification was to change a crank to a wheel and axle. This way, it would be easier to turn, and would add one more simple machine to our overall machine. Also, we did not have a crank that we could use.



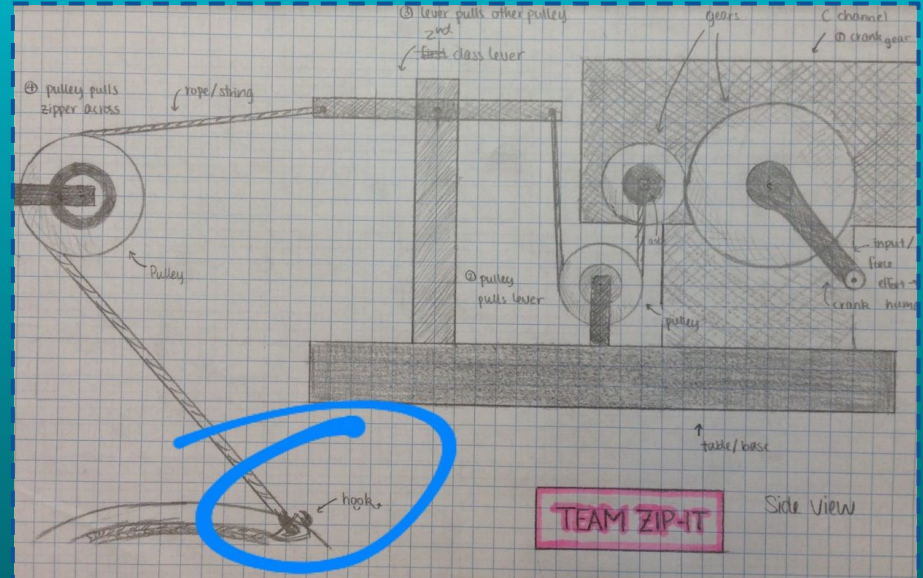
Prototype Modification #6

Our sixth modification was to add base plates between the two main bases. This way, when we use our pulley to zip up the backpack, the two plates will not be dragged toward one another.



Prototype Modification #7

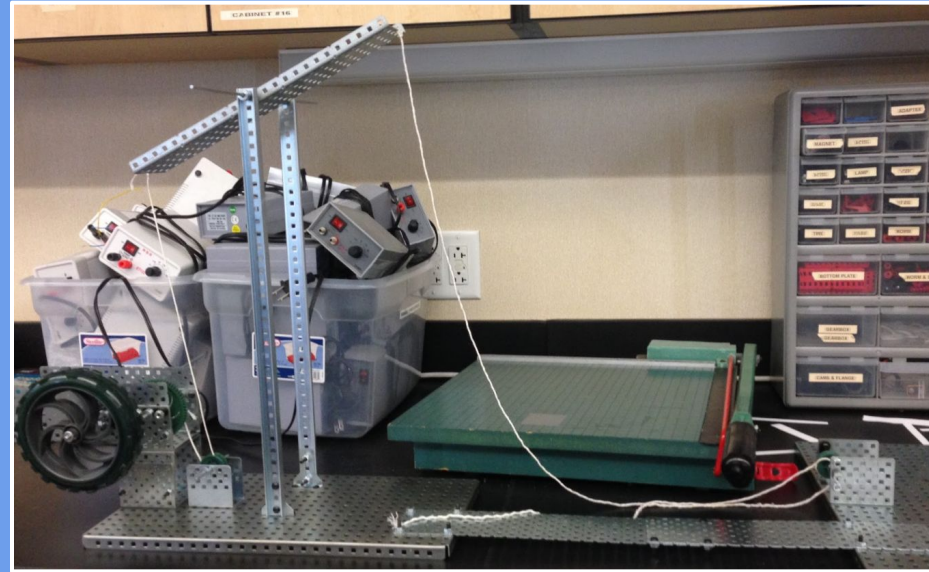
Our seventh and last modification was to remove the hook. We had two reasons for this: the first is because tying the string works better, and the second is that we don't have a hook that we could use.



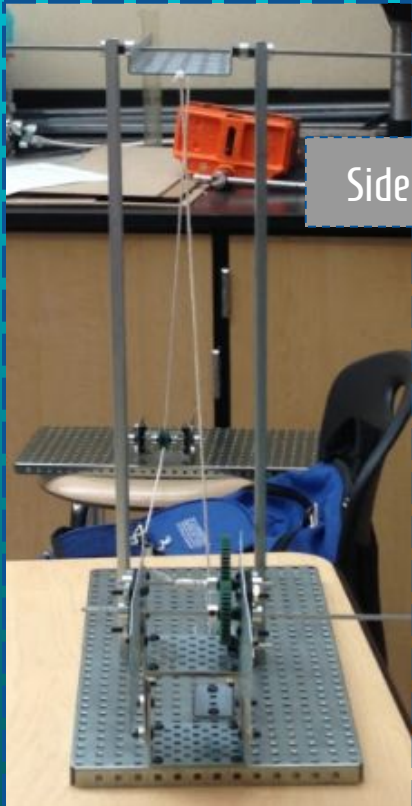
Final Design

The first step is to turn the wheel, and then...

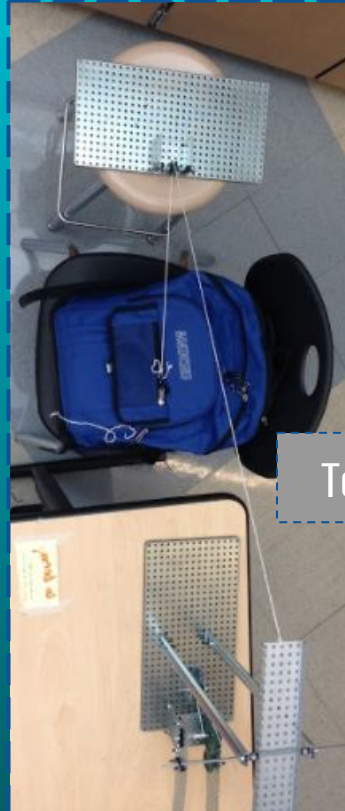
- The wheel will turn the axle, which will turn the gear
- The smaller gear will turn the larger gear
 - The gears are geared for torque
- The gear will turn a string that is tied to the axle, which will go through a pulley and pull a first class lever down
- As the first class lever tilts, the higher side will pull another string tighter
- This other string will go through a pulley and is tied to the zipper of a backpack
- As the string gets tighter, the zipper will be pulled closed or opened



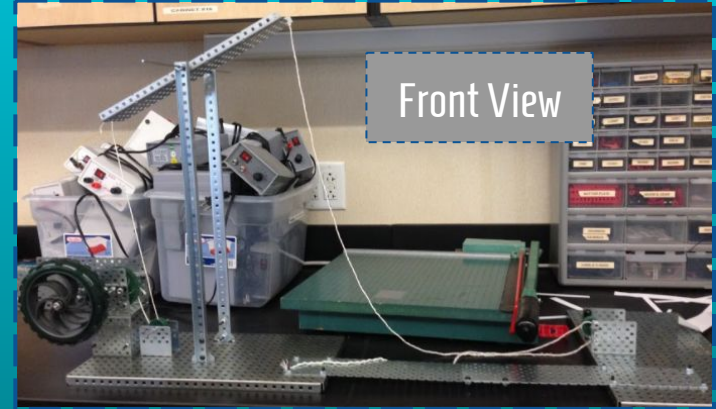
Different Views:



Side View

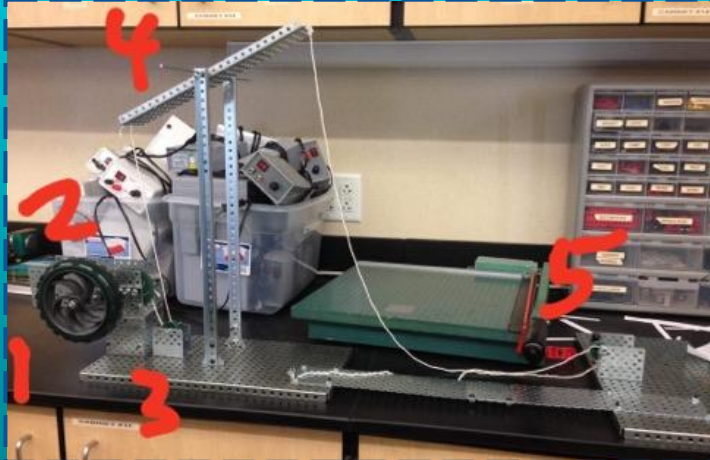


Top View



Front View

Order:



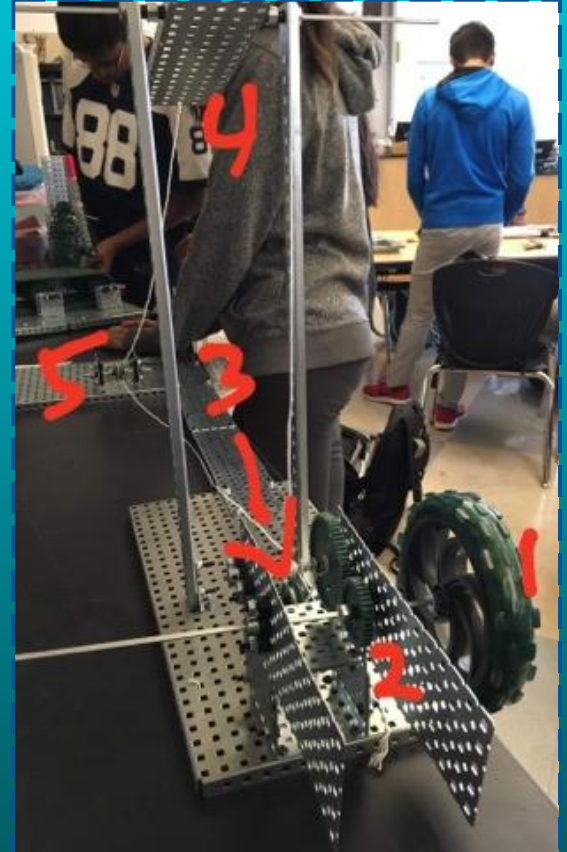
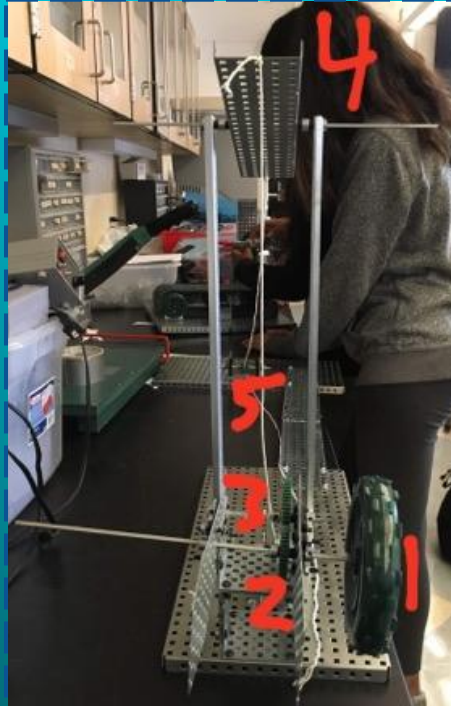
1 - Wheel and Axle

2 - Gear Train

3 - Pulley #1

4 - First Class Lever

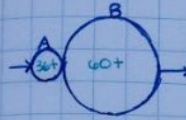
5 - Pulley #2



Final Mechanical Advantage Calculations

Project Compound IMA Calculations:

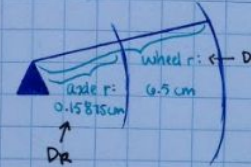
Gear Train:



$$GR \cdot IMA = \frac{60}{30}$$

$$IMA = 1.67 \leftarrow 1.666666666$$

Wheel & Axle:



$$IMA = \frac{D_E}{D_R}$$

$$IMA = \frac{6.5 \text{ cm}}{0.15875 \text{ cm}}$$

$$IMA = 40.94488189$$

$$IMA \approx 40.94$$

Pulley #1:



$$IMA = 2$$

because there are two strands

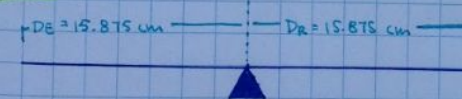
Pulley #2:



$$IMA = 2$$

because there are two strands

Lever:



$$IMA = \frac{D_E}{D_R}$$

$$IMA = \frac{15.875 \text{ cm}}{15.875 \text{ cm}}$$

$$IMA = 1$$

Total IMA:

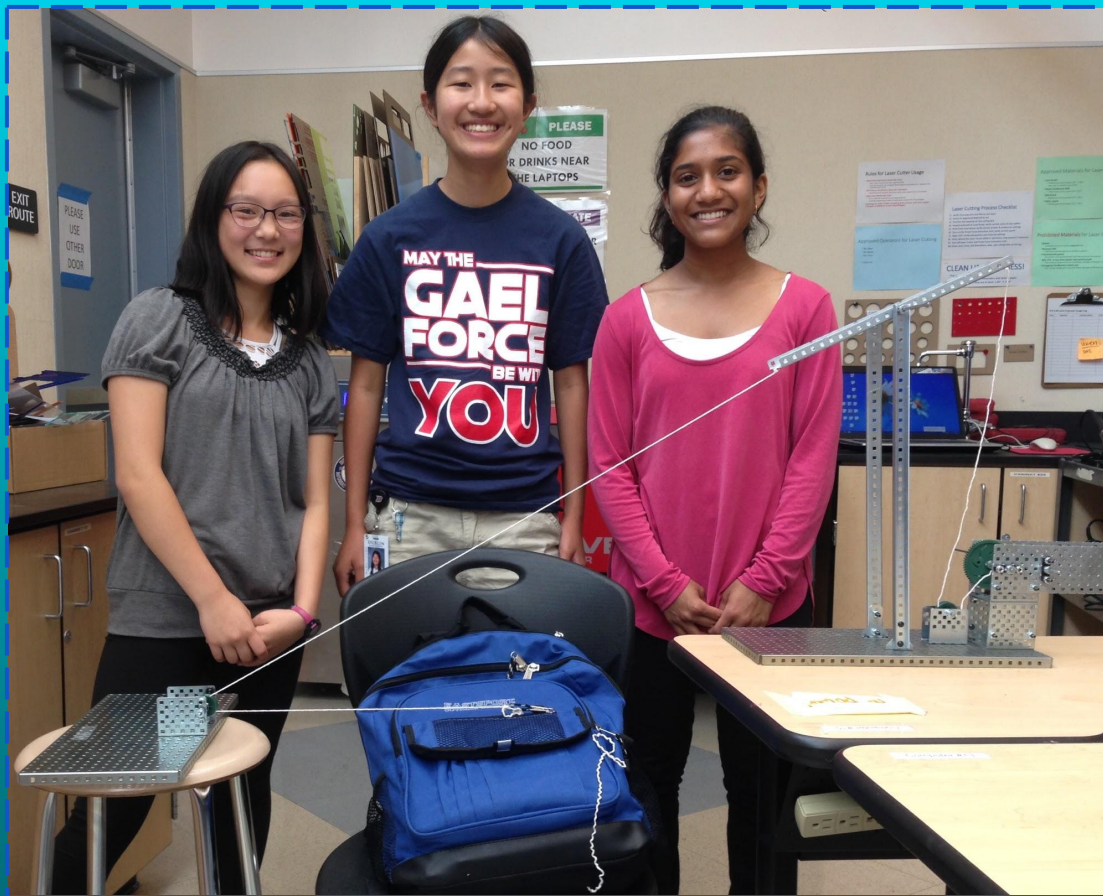
$$IMA = 1.66666 \times 40.94488189 \times 2 \times 2 = 1$$

$$IMA = 272.965878$$

$$IMA \approx 272.97$$

Our Gantt Chart:

	A	B	C	D	E	F	G	H	I	J	K
1			08/30/17	08/31/17	09/05/17	09/06/17	09/07/17	09/08/17	09/11/17		
2	Lever				Roshni	Melody				Roshni + Jessica	Roshni
3	Gear Train			Jessica						Roshni + Melody	Jessica
4	Pulley Systems and Support									Jessica + Melody	Melody
5	Brainstorm Sketches		Melody								All
6	Final Sketch										
7	Presentation								Melody		
8	Connect Parts					Melody					
9	Test Prototype and Modify					Melody	Roshni				
10	Documentation - Modifications					Melody	Roshni	Roshni			
11	Design Statement				Roshni						
12	Record Measurements						Roshni				
13	Calculations						Melody	Melody			
14	Format Online Documentation							Roshni			
15	Take Pictures!!					Melody	Melody	Melody			
16	Presentation PPT						Roshni	Roshni			
17	Final Design						Roshni	Roshni			



Signing off,
Team Zip-It

Roshni Vakil

Melody X Wong

Jessica Yin