



Catapult Project

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EGR 107.002

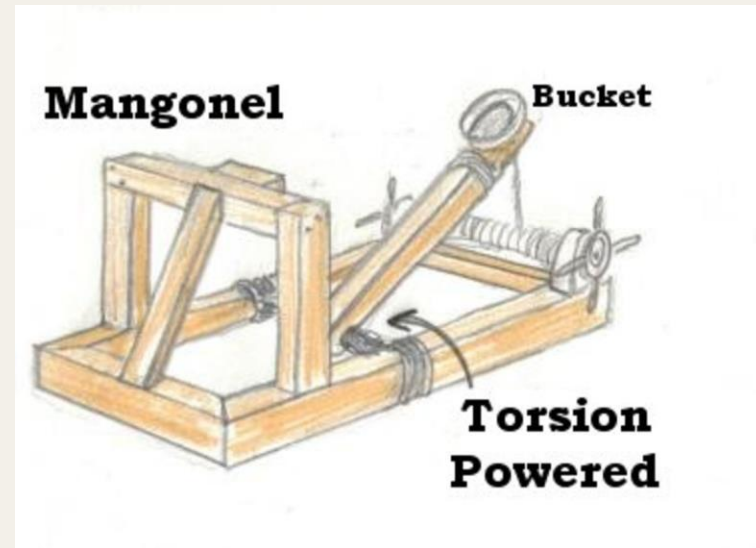
Gill 5

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Project Description

A mangonel style catapult had to be constructed with following specifications in mind:

- Able to be built in 30 minutes
- With the materials given
- Cost less than \$10 dollars to construct
- Had to be launched with the launch string given
- No human force can be used
- Launch a ½ inch gumball
- Hit a target with a foot radius that is 10 feet away for accuracy event
- Launch a ½ inch gumball a far distance for distance event



Auction and Economic Event

- +The auction consisted of teams placing bids via Google Forms for their buying decision. Each auction for each position lasted 30 seconds.
- +The economic event is a randomize event imitating real ones. All possible events are negative and result in materials either increasing in price or decrease in availability.

Details of Competition Events



+ The two competition events are:

Accuracy – Catapults will have to launch a $\frac{1}{2}$ inch gumball at a target with a radius of 1 foot and is 10 feet away. Each catapult will launch 10 times, the catapult that hits the target the most times wins.

Distance – Catapults will launch a $\frac{1}{2}$ inch gumball as far as it can. Each catapult will launch 3 times, the catapult with the farthest distance wins the competition.

Timeline for Project

Deadline	Date
Catapult Proposal	October 21st, 2022
Catapult PDR	October 30th, 2022
Catapult Test Plan	November 6th, 2022
Catapult Demo Video	November 13th, 2022
Catapult Competition	November 21st, 2022
Catapult CDR	December 5th, 2022
Catapult CDR Presentation	December 6th, 2022
Catapult Teammate Performance Rating	December 10th, 2022

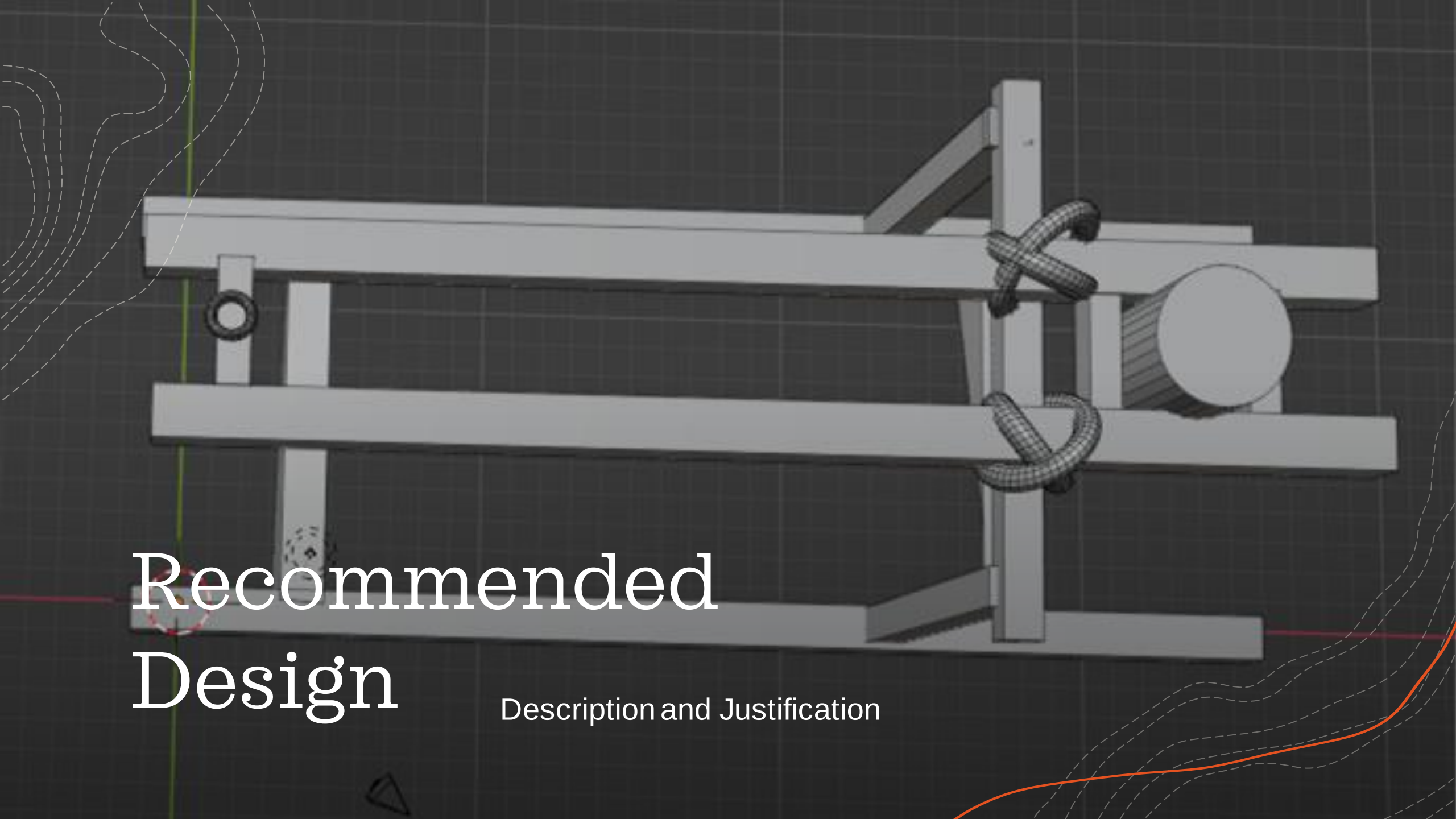
Project Specifications

- + Catapult had specific materials and parts that could be chosen from to use in the designs. (more in detail on next slide)
- + Materials were worth a certain amount and each team was awarded \$10 to spend on parts
- + No specific dimensions- but design can only stay in the dimensions the materials provided can create
- + Must be able to repetitively launch a $\frac{1}{2}$ in gumball 10 times within a 1 ft radius that is 10 ft away
- + Must be able to launch a $\frac{1}{2}$ in gumball a far distance one time



Materials Design could use

• 2 Magazines (\$4 each) • 2 Newspapers (\$2.50 each) • 2 Notebooks, 70pg spiral (\$1.50 each) • 30 Popsicle Sticks (\$0.10 each) • 10 Tongue depressors (\$0.25 each) • 4 Masking tapes (\$4 each) • 3 Packing tapes (\$2 each) • 2 Duct tapes (\$6 each)	• 6 Dixie cups, 3 oz (\$0.75 each) • 6 Plastic cups, 16 oz (\$1.50 each) • 6 Soda cans, 12 oz (\$1 each) • 6 Soda cans, 7.5 oz (\$0.75 each) • 4 oz (½ a bag) of Rubber bands, 2" d, ¼"w (\$0.10 each) • 4 oz (½ a bag) of Rubber bands, 2"d, 1" w, (\$0.25 each)	• 4 Soup cans, 12 oz (\$1 each) • 4 Plastic spoons (\$0.05 each) • 4 Plastic knives (\$0.05 each) • 3 Plastic bottle caps, 2L (\$0.10 each) • 2 2L plastic bottle (\$2 each) • 3 Milk jugs, 1 gallon (\$2 each) • 3 Gatorade bottles, 12 oz (\$1.50)	• Cotton string, 10 ft in 1 ft lengths (\$0.50 each) • 20 Pencils (\$0.10 each) • 8 pairs of chopsticks (\$0.50 each pair) • 2 small tubes of Super glue (\$3 each)
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Recommended Design

Description and Justification

Feasibility Analysis

Feasibility Criteria	Selected Design
Cost less than \$10 to build	✓
Has an arm	✓
Has a pivot point	✓
Able to launch a half-inch gumball	✓
Hit a target with a 1-foot radius that is 10 feet away	✓
Must only be built from the supplies provided	✓
Can be built within 30 minutes	✓
Force produced is not human generated	✓
The catapult is launched from the launch string	✓

Merit Analysis

Design 1

Merit Criteria	Weight	Value	Score	Score Weighted
Cost	40%	\$6.45	9.5	3.8
Weight	30%	~ 380 g	9.5	2.85
Parts Used	30%	15	5	1.5
Total:	100%		24	8.15

Failure Modes Effects Analysis

Process or Product Name:	Selected Design (Magonel-Style Catapult)
Process Owner:	Gill Team 5

Prepared by:	Victoria Smith and Zane Bush	Page: 1 of 1
FMEA Date (Orig):	10/29/2022	Rev.

Design Function	Potential Failure Mode	Potential Failure Effects	S V E	Potential Causes	O C C	Current Controls	D T E	R N P	Actions Recommended	Resp.	Actions Taken	S V E	O C C	D T E	R N P
What is the desired design function or goal?	In what ways can the Design fail?	What is the impact on the Key Output Variables once it fails (customer/design requirements)?	How Severe is the effect to the customer?	What causes the Key Input to go wrong?	How often does cause or FM occur?	What are the existing controls and procedures that prevent either the Cause or the Failure Mode?	How well can you detect the Cause or the Failure Mode?		What are the actions for reducing the occurrence of the cause, or improving detection?	Who is Responsible for the recommended action?	Note the actions taken. Include dates of completion.				
Arm Launches Gumball	Arm falls off	Gumball cannot be launched	2	Rubber bands break	7	N/A	3	42	Use an additional adhesive	Victoria Smith	N/A	2	4	3	24
			2	There is not enough glue	8	N/A	4	64	Use an additional adhesive or more glue	Victoria Smith	N/A	2	4	4	32
			2	One side is too heavy	6	N/A	4	48	Use a strong or additional adhesive	Victoria Smith	N/A	2	4	4	32
	Arm does not move	Gumball cannot be launched	2	The arm experience extreme resistance from the rubber	3	N/A	5	30	Test and manually move the arm before launching	Victoria Smith	N/A	2	3	2	12
	The catapult falls over	Gumball cannot be launched especially with accuracy	3	One side is too heavy	6	N/A	1	18	A counter weight on the opposite side	Victoria Smith	N/A	2	3	1	6
Catapult is able to hit a 1 foot radius accurately from 10 feet away	Arm excessively moves so it does not hit the target accurately	Catapult does not hit the target accurately	1	Not enough adhesive is used	3	N/A	3	9	An additional adhesive is used	Victoria Smith	N/A	1	2	3	6
	Gumball is not secure or moves around loosely within the bottle cap	Catapult does not hit the target accurately	1	Bottle ca is significantly bigger than the gumball	2	(Assumed) That the cap will be close to size of the gumball	1	2	Bottle cap is lined so it better fits the gumball	Victoria Smith	N/a	1	1	1	1
								0							

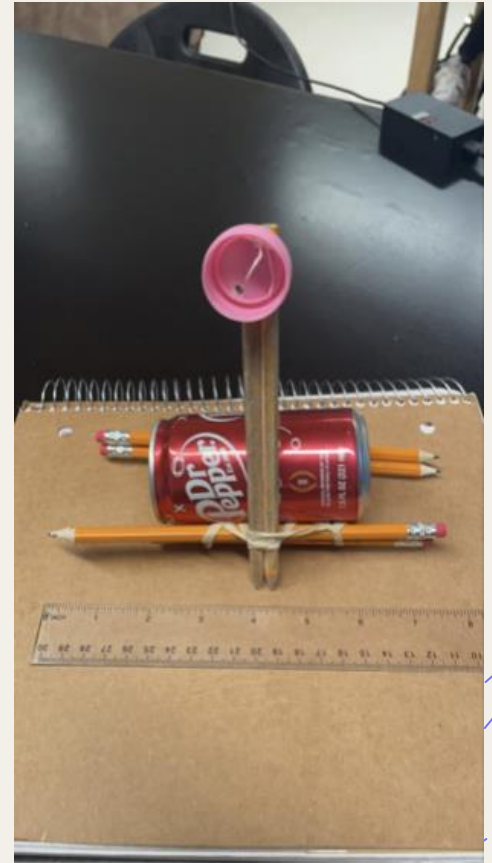
Purchase order for Auction and Economic Event that occurred

+ Auction Results

- + Gill 5 won 1st place for purchase order for parts
- + 1st place cost the group \$3.51 to claim the spot

+ Economic event- Wood and paper products doubled in price

- + Group had to decide what materials were needed the most and how many pencils to buy after the economic event occurred



Preliminary Testing



Time to Build
Test



Accuracy
Test



Distance
Test



Load Test



Balance Test

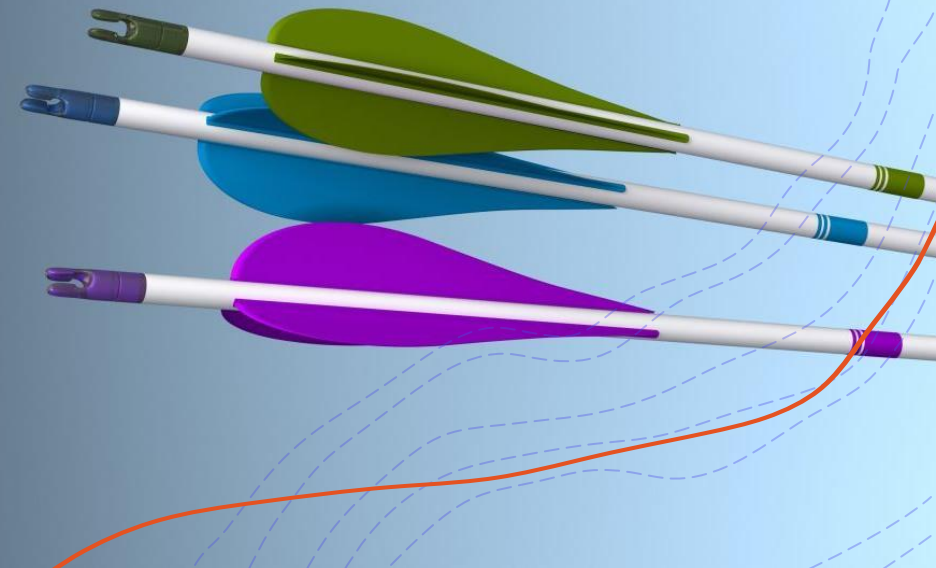


Time to Build Test

- + This test requires the materials used to make the catapult, sandpaper, and a timer. The timer was set for 30 minutes as the catapult was built. The catapult was able to be built within 30 minutes, with a time of 24 minutes and 27 seconds.

Accuracy Test

- + The accuracy test was performed to ensure the catapult was able to perform well on competition day
 - + Used the built catapult, wooden beads, tape measurer, and a paper towel roll
- + Out of 15 shots, the wooden bead hit the target 2 times
 - + Following the test, pencils were repositioned to allow the arm of the catapult to move less to make each shot more accurate



Distance Test

- + This test was performed with the use of a built catapult, wooden bead, a marker, two paper towel rolls, and a tape measure
 - + Marker was used to mark how far bead would travel
- + Results:
 - + Test was completed 10 times launching distances of 10, 15, and 20 ft
 - + Distances averaged between 11 and 12 feet.
 - + Out of these launches, 6 of them were 15 ft and over



Load Test

- + This test required the built catapult, 5 AA batteries, tape, and a hair tie. The catapult was able to launch with the additional load on the arm.

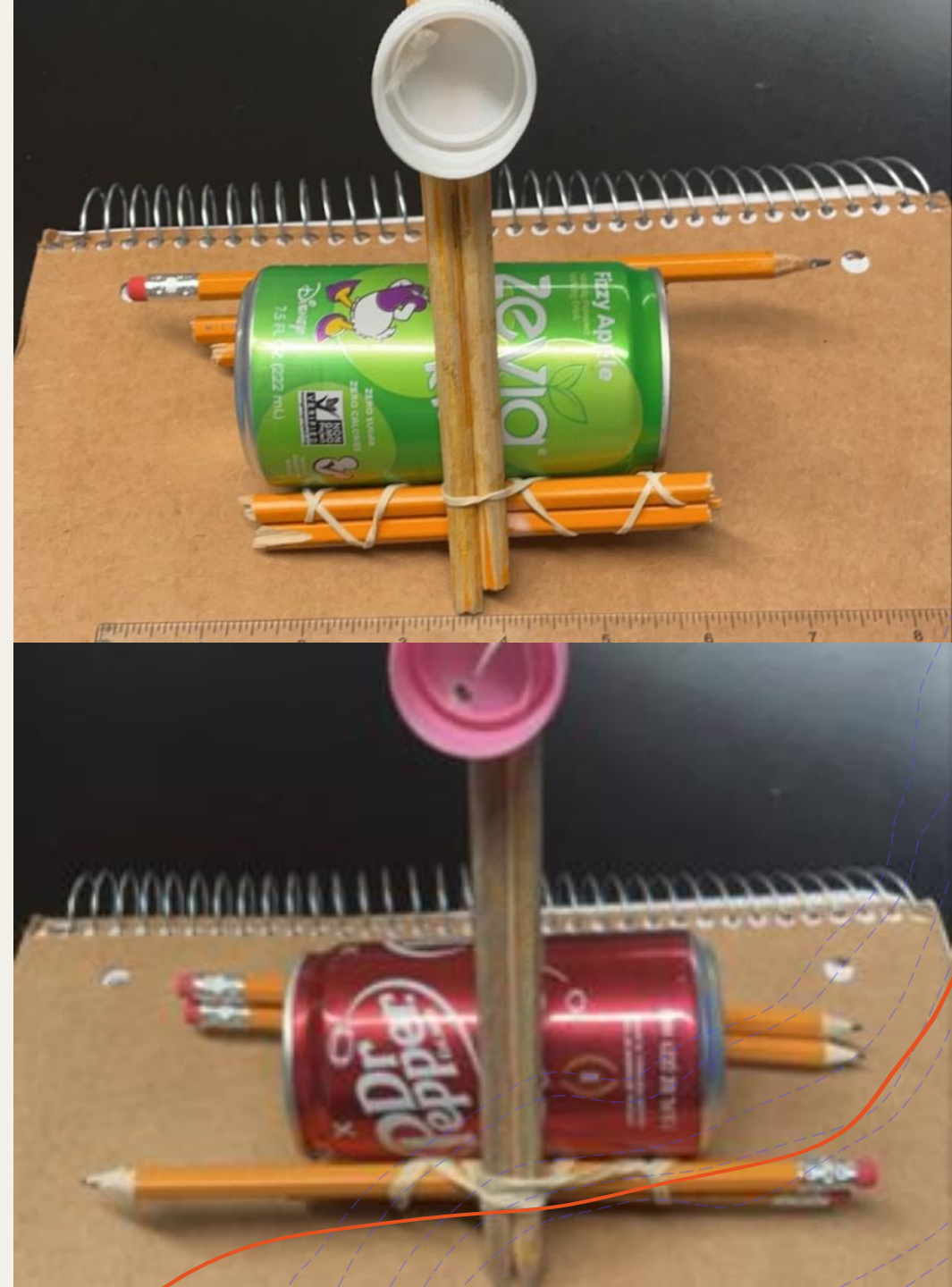


Balance Test

- + The test required the built catapult and a 16.9 fluid ounce water bottle. The catapult slightly tipped when the water bottle was placed on opposing sides of its body. The catapult did tip over when the weight was applied on its arm.

Competition Results

The main modification between the prototype and the catapult used were the rubber bands.



Competition Results (Cont)

Accuracy Results

+ Out of the 10 shots made, none of them had hit the target. This was due to the change rubber bands, which the FMEA did not account for.

Power/Distance Results

+ The farthest launch made by the catapult during the competition was 10 feet. This was due to a change in rubber bands, which the FMEA did not account for.

Conclusion

Thank you! Do you have any questions?

