Ocean's 11

Danny Chmaytelli, Alexa Duffy, Aidan Hernandez, Joshua Kim-Pearson, Aiden Lee, Francisco Martinez Devis, Matthew McAuliffe, Dylan Neumeyer, Anthony Sugars

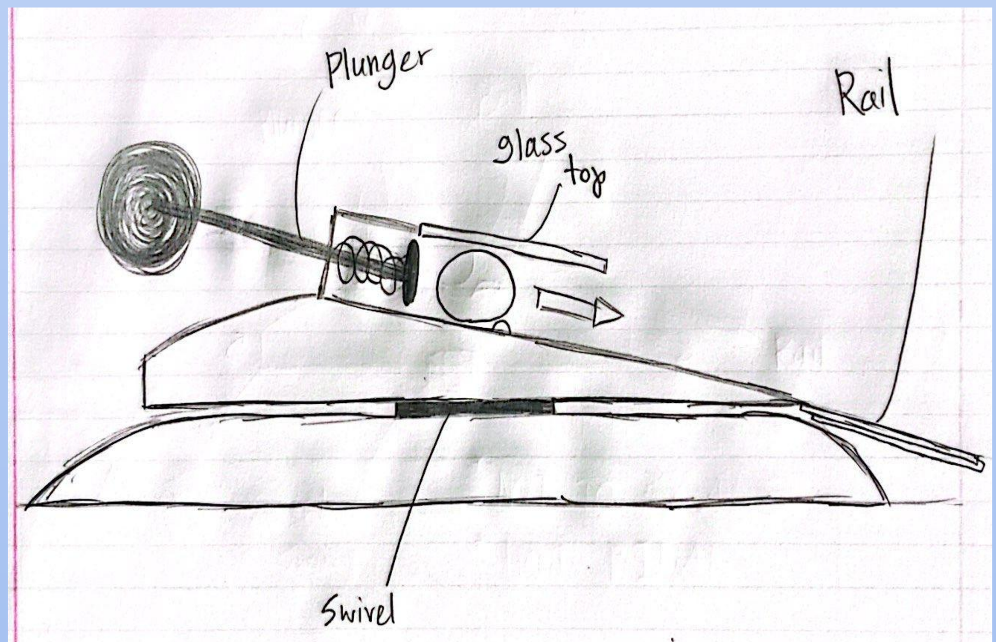
Goals, Rules, and Research

Objective: The goal is to design a device that hits five balls into five targets (each target in a different location) in order to get the most points possible within 5 minutes.

Rules & Restrictions: The ball must be hit by an applied force, the entire device must be within a 1x1 meter square, and there can be no human interference during the operation of the device.

Problem Statement:: The ball must be hit with a striking motion and travel a certain distance into a specified wicket.

Initial Research: A pinball based design with a swivel base and rail system meant to launch the ball in any given direction with maximum speed, and maximum accuracy.



Ocean 11's Members

Aiden Lee

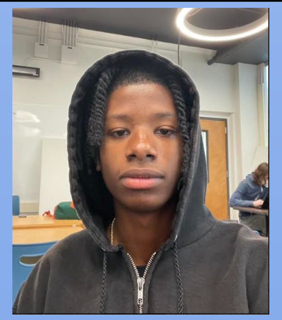
Group leader, Worked on Building, Documentation, Advertisement, and Poster

Alexa Duffy

Documenter: Wrote, organized, and edited most of the team document; Drew up design concepts; Performed physics calculations.

Aidan Hernandez

Part of Build Team and Design Team, suggested ideas like the Lazy Susan and laser pointers.



Anthony Sugars

A part of Build Team and Design along with material request and the testing process. Measured materials and used varios power tools to make precise cuts in materials.

Matthew Mcauliffe

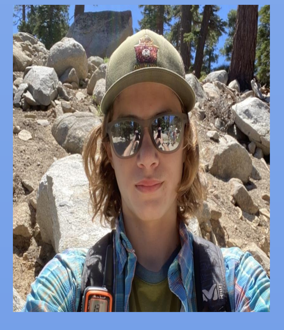
Designed all of the CAD files, and suggested multiple ideas as a part of the Design Team. Also measured pieces as a part of the Build Team.

Joshua Kim-Pearson

Build team member. Thought up ideas and concepts, like the hammer holder, and top brace. in general, contributed most of his time to making the device.

Francisco Martinez Devis

Worked with build team and materials team. Worked on designs of build.



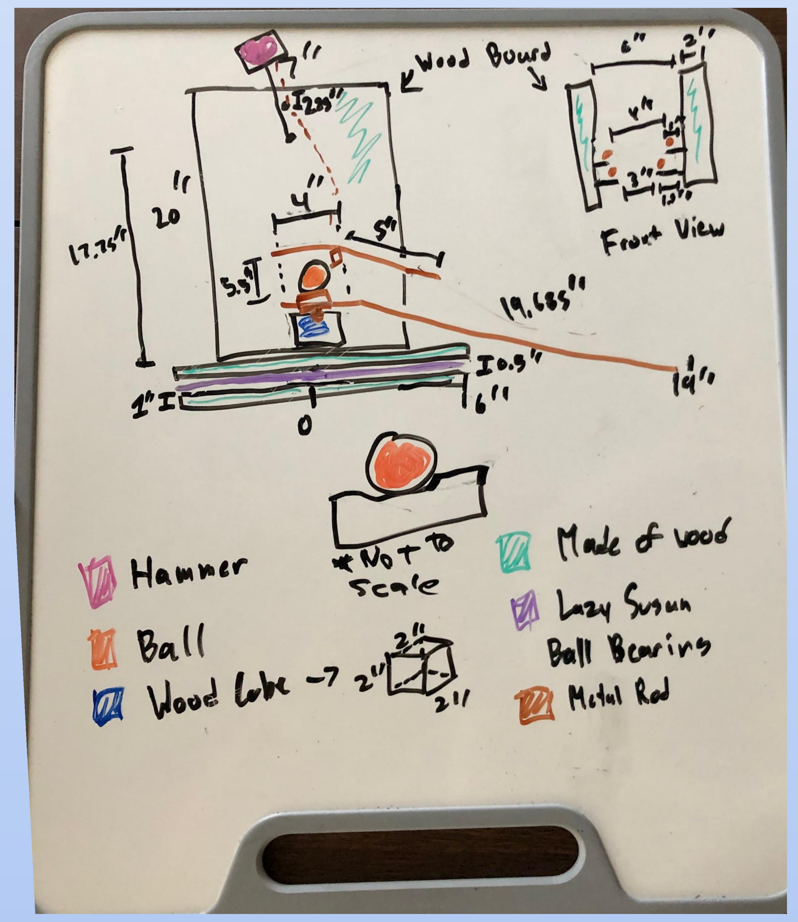
Dylan Neumeyer

Part of Design team and has contributed greatly to the building of the device. Also helps with documentation.

Danny Chmaytelli

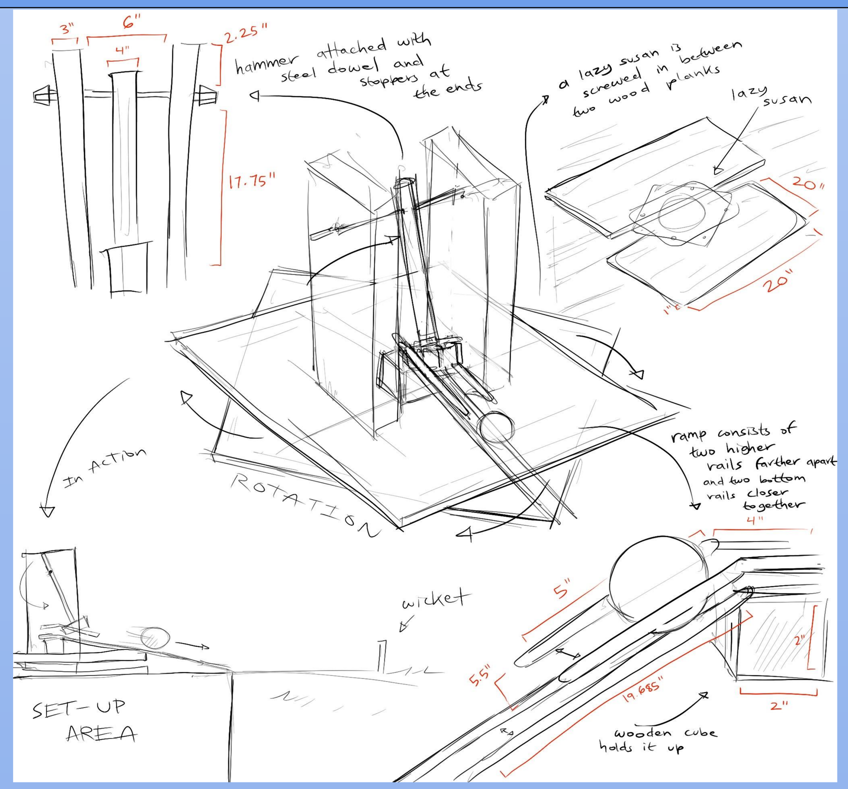
Did physics calculations to calculate theoretical performance of device, helped write and proofread components

Initial Design Concept



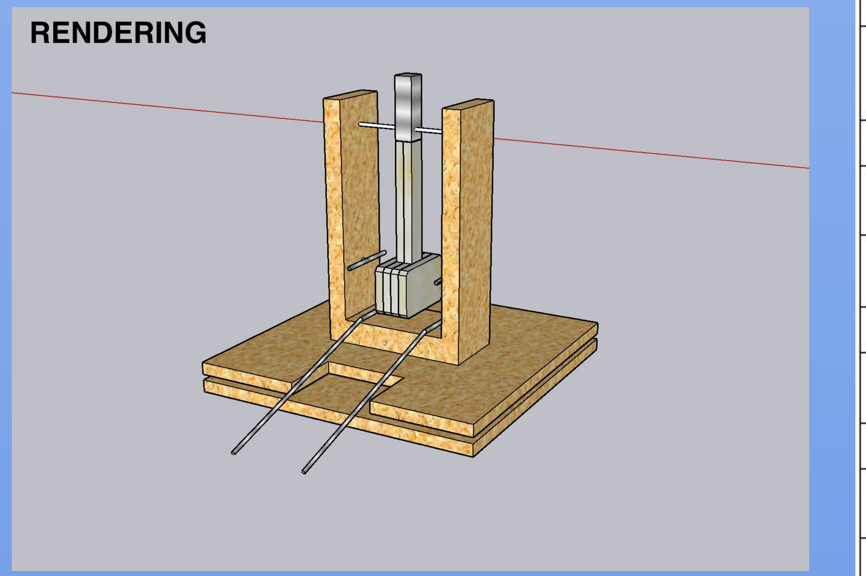
The initial design with measurements and color coded component materials. There is a large cross-section looking through the right support plank and into the central mechanism. On the top right, there is a view of the front without the hammer to show the measurements of the rails that will guide the ball. Also shown is the basic design developed to hold the ball in place before it is struck by the hammer.

Revised Design Concept



More detailed revision with a multitude of viewpoints and measurements. In the center is a complete view of the device. In the bottom right, there is a detailed close up on the ball with its guide rails and the starting point block. In the bottom left there is a general cross section to reveal the mechanics hidden behind the wood planks. The top left has a front view of just the hammer with its respective measurements. In the top right there is an exploded-view drawing of the lazy susan swivel within the base.

Prototype Model/Cost Analysis

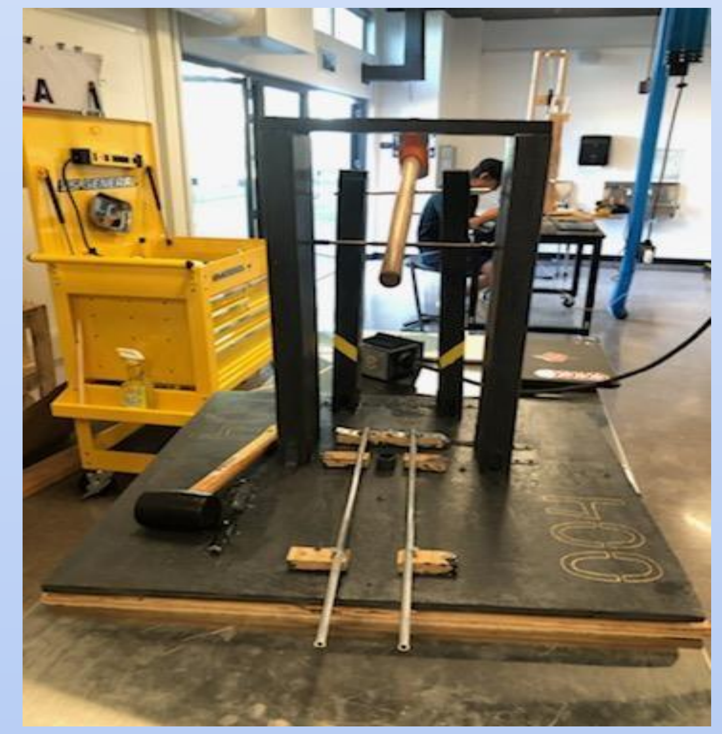


CAD DESIGN

Part	Number Ordered	Cost per Part	Total Cost
6" wide 4 ft tall Wooden Plank	1	$9.92	$9.92
Hammer	1	$24.77	$24.77
Hollow Metal Rails	3	$7	$21.00
L Braces	1 (40 per pack)	$7	$7.00
Bearing	1	$6.99	$6.99
Base Wood Boards	1	$17.28	$17.28
Steel Dowel	1	$3.93	$3.93
Laser Pointer	1	$17.59	$17.59
Labor Hours	48	25.6	$1228.80
			$1337.28

Cost Analysis

Final Product

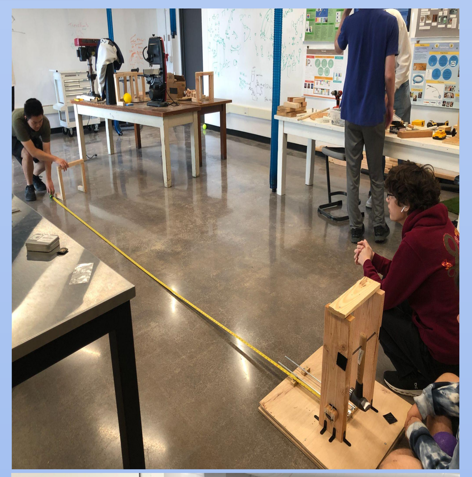


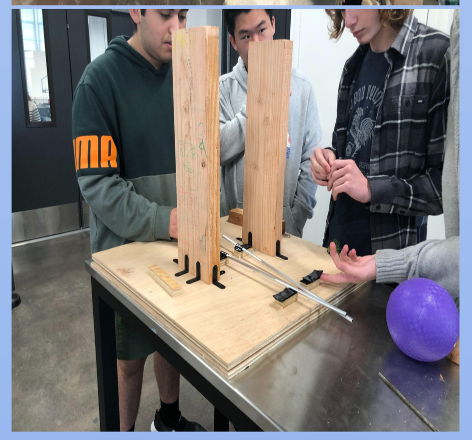
Equipment and Tech

Woodcutters are used on the large base wooden piece to divide it into two equal parts, so that the piece ends up as two flat planks. A saw is then used to actually cut the piece. Afterwards, the tape measure and marker are used to mark where the two base planks should be drilled. A drill is then used to actually drill the holes. Finally, a screwdriver is used to secure the lazy susan in between the two wood planks, and a level is used to make sure the base is level.

Build Progression

Test Procedure





Test Criteria

Criteria/Benchmark	Description of data needed	Quantitative or qualitative	Results Upon Testing	Criteria Pass/Fail
Time to fire 5 balls in under 1 minute	Number of seconds between the first ball being fired and the last ball being fired during testing	Quantitative	29.78 Seconds	Pass
Time to set up device in under 3 minutes	Number of seconds needed to set up device during testing	Quantitative	15 seconds	Pass
Device fits within 1x1 meter starting area	Yes/No	Qualitative	Yes	Pass
Device is initiated by a single event	Yes/No	Qualitative	Yes	Pass
Device is loaded with a ball	Yes/No	Qualitative	Yes	Pass
Device strikes ball and does not push ball	Yes/No	Qualitative	Yes	Pass
Device remains within the set up area during the entire task	Yes/No	Qualitative	Yes	Pass
Device uses safe energy sources	Yes/No	Qualitative	Yes	Pass

The device is primarily made out of wood, with the base consisting of two horizontal square wood boards with dimensions 24 inches by 24 inches by 0.5 inches. First, the wooden base pieces were attached to the top and bottom of a lazy susan with dimensions 6 inches by 6 inches by 0.5 inches, using a screwdriver. The device was refined in order to improve its accuracy and consistency. To achieve this goal, the device was tested multiple times through trials that simulate the actual competition, as defined by parameters in the official JPL rules.

Physics Calculations and Device Limitations

$$(M_H)(g)(D_H) = (\tfrac{1}{2})(M_H)(V_H^2) \quad COR = \frac{V_2}{V_1} = \sqrt{\frac{H_f}{H_i}}$$

$$(M_H)(V_H) = (M_H)(V_{H2}) + (M_B)(V_B) \quad V_B = \frac{(M_H)(V_H+V_R)}{(M_H+M_B)}$$

$$M_H = 1.361\ kg \quad M_B = 0.119\ kg \quad D_H = 0.4068\ m$$

$$D_H = (9.75 + 9.75\cos(50°))\ in = 16.017\ in$$

$$V_H = \sqrt{(2)(g)(D_H)} \quad V_H = \sqrt{(2)(9.8\ m/s^2)(0.4068\ m)}$$

$$V_H = 2.824\ m/s \quad COR = \frac{V_2}{V_1} = \sqrt{\frac{27.5}{36}} = 0.874$$

$$V_R = (2.824\ m/s)(0.874) \quad V_R = 2.468\ m/s$$

$$V_B = \frac{(1.361\ kg)(2.824\ m/s+2.468\ m/s)}{(1.361\ kg+0.119\ kg)} = 4.866\ m/s$$

- Lower Angle
- Rotation reduces speed
- Friction reduces speed

Testing Results

Time (seconds)	Score
42	190
38	100
37	190
33	130
38	190
47	190
30	190
42	150
39	190
33	190
29	190
26	190
30	190
33	190
33	130
32	190
34	100
28	190
28	160
32	190
25	190
25	190
18	190
27	100