



# Santa Monica Goats United



## Objective



**Objective:**  
Create a device that propels rubber balls through a series of wedges in a 1 minute time frame. We must score as many points as possible.

**Rules & Restrictions:**

- There are 5 wedges (inspired soccer goals) which are the targets.
- Targets B and C are worth 10 points each.
- Target A is worth 30 points.
- Balls must be launched without any external force (shooting motion, no physical push from a person).
- Must utilize safe energy sources.
- There is a specific order that balls must be followed (from the highest multiplier to the lowest).
- Blue ball has a 2x multiplier.
- Red and Yellow balls have a 1x multiplier.
- Green and Orange balls have a 1x multiplier.
- All 5 balls must be launched within 60 seconds.

**Our Device:**  
To accomplish the task at hand, many revisions have been made. Ultimately the built team opted for the use of a 6 inch pvc pipe followed by a wooden ramp where the ball would smoothly be guided to the wedges. Other design choices utilized steel for the inclusion of a better mechanism on the base that would allow for quick direction adjustments, as well as laser pointer mounted onto the ramp and point to help improve accuracy.

Figure 16: Court Specifications

## Final Product

Our final design incorporates aspects from each of our previous iterations. After abandoning the pvc tube tunnel (Figure 11) we settled on a ramp made from thin sheets of plywood as shown in Figure 4. This design allows us to make fine modifications to the trajectory of the ball. The ball, which is suspended by a flexible zip tie, is stored near the top of the rails. Additionally, the final iteration uses a simple, gravity fed, launching mechanism which is highlighted in figure 6. It consists of a pvc tube with a smaller diameter metal pipe inside. After removing a pin, the metal pipe propels the ball down the ramp.



Figure 1: Figure 5: Figure 7: Figure 8:

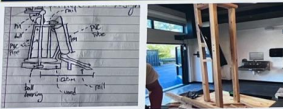
## Prototype Design



Figure 10: Figure 11:

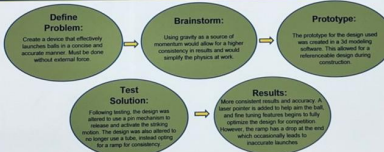
This 3D design created in CAD served as a reference for building the physical design, as well as the final step before beginning the physical build. Although aspects have been revised the core outline has remained the same.

## Initial Design



The initial design for the device utilized a pendulum striking motion to propel the ball. It would also make use of a wheel at the base for quick adjustments for the varied wedge placements.

## Design Process



## Cost Analysis



Figure 12: Material Costs

Figure 13: Labor Costs

Using the average salary of a construction laborer for two months of work (\$4,478) and multiplying it to our group size, as well as determining the total material costs for the design, we were able to determine the net cost for the entirety of the project (\$42,465).

## Testing



## Physics Analysis

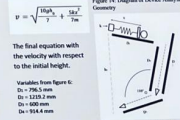


Figure 14: Diagram of Physics Analysis

The final equation with the velocity with respect to the initial height.

Variables from Figure 6:  
D = 750.2 mm  
D = 1230.2 mm  
D = 1000 mm  
D = 954.4 mm

Figure 15: Theoretical Performance with Initial Height (PH) and Velocity (V)

## Group Members

**Benjamin Burnett**  
Responsible for conceptualization and construction of physical design.

**Kameron Bernick**  
Responsible for conceptualization and construction of physical design.

**Alexander Braxton**  
One of the main contributors for the construction project. They are collaborative in the research document.

**Thomas Deffenbacher**  
One of the main contributors for the construction project. They are collaborative in the research document.

**Matthew Bennett**  
Responsible for the construction of the physical design through the entire project.

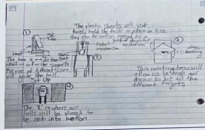
**Austin Palmer**  
Responsible for the construction of the physical design through the entire project.

**Sebastian Dipe**  
Responsible for the construction of the physical design through the entire project.

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Responsible for the construction of the physical design through the entire project.

**Michael Wheeler Gaskew**  
Responsible for the construction of the physical design through the entire project.

## Revised Design



The measurements and structure was finalized for the revised design concept, with a better understanding of how the bearing works to rotate the base. The starting mechanism was also changed to include a pinball mechanism pushing through plastic sheets instead of a hammer so as to not worry about creating a supporting base.

## Equipment



With this project being primarily made out of wood and PVC piping, it was found that the most common array of tools used were saws to cut the wood into the necessary shapes and sizes needed, as well as electric power tools for the less malleable materials used.