(Space) Ballz of Fury

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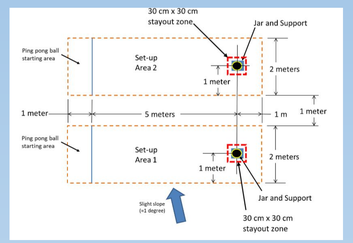
JPL Objective



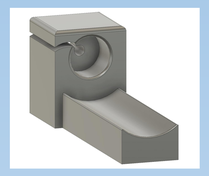
Objective: Create a device that can move up to 10 ping pong balls into a jar located 5 meters away in under a minute. The winner will be the team that moves the highest number of ping pong balls into the jar.

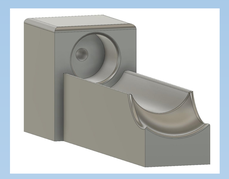
Rules & Restrictions: Only a ping-pong ball can be transported in multiple runs. Each run must be initiated by a single operation; no human power may be used, no remote controlled devices are allowed. The device should remain within the dimensional limits.

Our Device: A spring-powered mechanism that, with a flip of a notch/switch, shoots the ball up a tube to a certain point before gravity carries it down another.

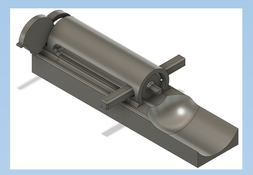
Pictures of Device

Initial design for launcher (uses string & spring):

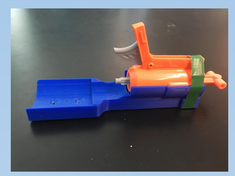




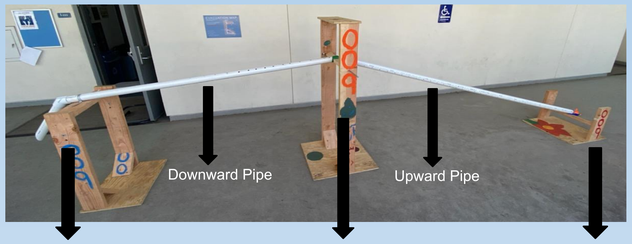
Second design (3D model + 3D printed version):



Final launcher:



Final prototype design:



Final Base (contains 2nd connector piece with additional pipe)

Middle Base (contains 1st connector piece & adjustable notch)

Launching Point (contains spring-launcher & first base)

Testing & Assembly:

Design Process

Define Problem:

The objective of this competition was to design a system that could move at least 10 ping-pong balls into a jar 5 meters away from the starting position in under a minute.

Our launcher needed to be powerful enough to shoot the ball down the path and into the jar despite multiple variables. Also, the process needed to be consistent enough so that we could replicate the process every single run.

Brainstorm:

The very first design we made was a pulley system that we thought could possibly shoot the ball by cutting the string and using the force of a weight to launch it.

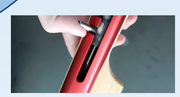
In the next design we decided to use a spring which could launch the ball of hitting it with enough force at a certain point. In this we also thought to use a spring but it was inefficient.

We thought of using a funnel system for the end of the path to help direct the ball but we decided against that so we thought to shoot the ball straight through the pipe and fall in.

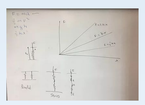
Prototype:

Our original device was also spring-powered but required the use of a string to pull back and launch the ball. We found that there were too many variables with this design and needed more force to up the pipe.

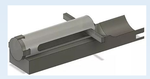
Our decision was to model the propeller after that of a marble-launcher, which could constantly shoot the ball swiftly up the pipe with the flip of a notch. In this phase we decided that our path would consist of two pipes, the first at an upward angle and the second at a downward angle to carry it down using gravity.



Marble Launcher - Inspiration



Spring System Brainstorming



3D Model Prototype Launcher

Testing/Assembly at JPL

Test Solution:

Adjusting the angle and making sure our launcher was consistent (and wouldn't break) was our main concern when testing. We had to make multiple bases after a few runs because we realized we needed to change the angle and the overall height.

In addition, we had to cut some of the pipes because when we redid the angle we needed to lower or heighten the end of the pipe.

Our connector piece was also an issue because it was too vulnerable and would crack if we put too much pressure on it.

Results:

During our test we were getting as many as 9 in and as few as 0 at times. We realized that the majority of the ball missed were those that were hit differently each run because of problems with the launcher. These problems also caused the balls to something fall back down the pipe because they were either hit at their bottom which caused them to bounce off the top of the pipe or because they weren't hit with enough force.
We also determined that we needed to make sure that all the parts of our design be aligned at certain measurements and the jar need to be exactly 6 inches away from the end of the pipe

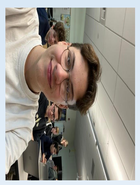
Competing at JPL

Future Modifications

In the future our goal would be to spend less time brainstorming and more time actually constructing our ideas to quickly figure out what works and what doesn't.
Here are our thoughts on what we should have physically changed:

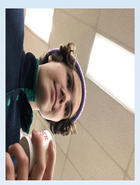
- we would make our bases more stable and build a more consistent track design.
- We should have gone to a hardware and tried our different connector piece angles and material.
- We would have looked for material that was overall less delicate.
- In the last two weeks we worked more with the angle and launcher which we should have done from the beginning.
- For the launcher, we should have considered not 3D printed material for the launcher after we saw how breakable it was but it was good to go off of as a starting point.
- We should have found a better system for aligning the ending portion of the path, rather than just eyeing it.

Group Members



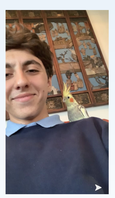
Cole helped build the launcher mechanism, oversaw tasks, helped build smaller components, wrote kanji on the stand, and photographed the group.

Micah helped with various aspects of the construction. He focused on the launcher to help make sure it functioned well. He also worked on testing the device to help troubleshoot.



Lily came up with initial designs, found materials to work with, facilitated the building of our project, worked on designing and building preliminary launcher designs.

Silas did the majority of the physical construction of the various iterations of our device. He measured, cut, and assembled the lumber and PVC pipes. He also contributed and developed an arrangement to the logistics of setting up the device.



Arian helped with launching and construction. He frequently acted as launcher for the device. He tested different launching techniques, and helped design the path of the device.

Eli came in and outside of class to help build and test frequently. He also 3D modeled and printed a pipe joint and each version of the launcher.

Dalia came often outside of class to help with troubleshooting. She also helped test the prototype and final design and decorated the bases. She also made the poster for the final project.

Competition Results

Regionals: We ended up getting four balls out of ten in the jar at the regional competition. There were, admittedly, factors that we had not considered like: pitch of the ground, the buoyancy of the new ping-pong balls, or the effect of the heat of the sun on the balls.

After this competition, we decided to change the angle of the path and launcher, making it steeper to increase the gravitational pull on the way down the final pipe. We also hammered in a nut and screwed in a bolt to decrease the speed down the pipe. In addition, we added an ending pipe with another angle to direct the ball into the jar. We made a stronger spring launcher that was more consistent (built out of a Nerf piece).

Finals: At the final competition, we got three balls out of ten in the jar. However, we did win largest entry which was a plus.