Mars Vehicle Trash Ejector

Finalist List

for

NASA HUNCH

Design and Prototyping 2021

Congratulations for being chosen as a Finalist for NASA HUNCH Design and Prototype 2021. Your design was chosen as a Finalist because your team has fulfilled all or most of the requirements for your project along with quality in design and manufacturing the prototype. Your team demonstrated good testing of your prototype and knowledge of the problems and extensive understanding of the environment for your project. There was a lot of really amazing competition for these spots and all people from the semi-finalist

By being a Finalist means that you are a winner but this does not mean your idea will fly to space. This is real engineering. Although it is possible the reviewers could see one design that is exactly what they want, it is more likely NASA may choose one or a few ideas from each team to incorporate into a different design. It is also very possible that requirements or needs have changed since the beginning of the school year and they are not interested in the idea at this time. This is the nature of engineering but it does not diminish your accomplishments.

Design to Flight

The goal of HUNCH is to keep your names attached to these ideas and to have you assist with later developments of your projects when possible. Your projects and information will be provided to Mike Bennett who runs the HUNCH Design to Flight program that will coordinate the sending of your ideas to the engineers as they request it and working with your team to give engineers assistance whenever possible. This might include updating or making new CAD drawings, assembly of prototypes, choosing flight components and/or assisting with presentations. You will receive an email through your teachers in the coming days requesting specific information about your project.

Patents

In general, NASA does not seek patents on materials that are only related to space, however, if there are other potential uses for the device or ideas related to Earth bound applications, HUNCH will ask NASA Tech Transfer to assist in working through patent process. It is our goal that students and schools are included in any patents with as much credit as possible. We do not anticipate this as an income generator but more as value to your resumes.

Presentations:

General:

- Practice your presentation.
- Look sharp and professional.
- Everyone from the team should talk.

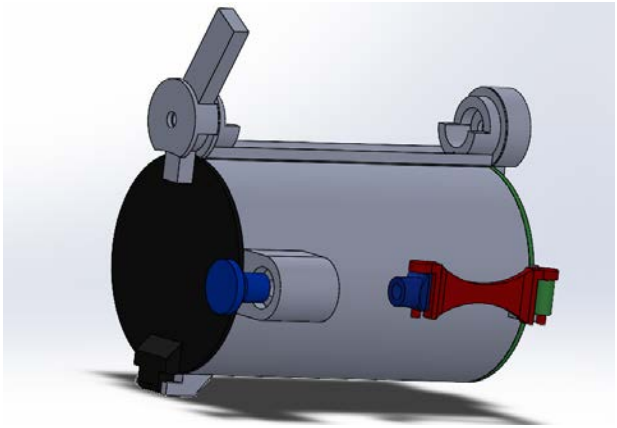
- Briefly introduce yourselves including your name and grade and school and state.
- Reviewers will already be aware of the problem and the constraints– I'll take care of that.
- Start with a demonstration of your prototype and briefly describe the testing that has been done.
- Point out details that make your design innovative, more robust, cleanable, repairable or desirable.
- Mention one or two things that didn't work initially but you were able to make changes and move forward.
- Briefly talk about how your prototype is different from the final product would be and include the materials you think will be used on the design that would fly to space.
- Answer questions quickly and concisely but completely so you can answer more questions and receive more comments. If you don't know something, say that you will have to check on it and plan to get back with them with an answer by email.
- Relax. These people are interested in what you have to say and know what its like to be on the spot.

Specific to Trash Ejector

- **Be prepared to talk about the gaskets and the safety that prevents losing air from the space craft.**
- **Maintenance of the system and repeatability of sending the trash out at a specified speed for its mass should be addressed.**
- You will be giving your talk with the other Finalists on **April 30—10:00 to 11:30 CT**
  I will be sending out invites for a Microsoft Teams meeting in the next couple of days to the teams.

Problem Statement

During space journeys, astronauts accumulate waste products. We needed to come up with a solution that would allow the astronauts to eliminate the waste they accumulated during their journeys.



Testing

By holding density constant, we scaled 5, 20, andk 20kg masses down to 109g, 219g, and 438g respectively for the size of one space beans can.

Taking 20 samples of 109g mass launches on lowest launch setting yielded a **mean initial velocity of 1.76 m/s** (slightly higher than allowed).

The launches were conducted straight up, and we used the final height and acceleration due to gravity to calculate initial velocity.

Future plans

- Calibrate for 1 m/s
- “Settings” for airlock system
- Improve tolerances and durability
- Design Air Storage System
- Investigate Winch System for full scale payloads

The Team

Miles Nash

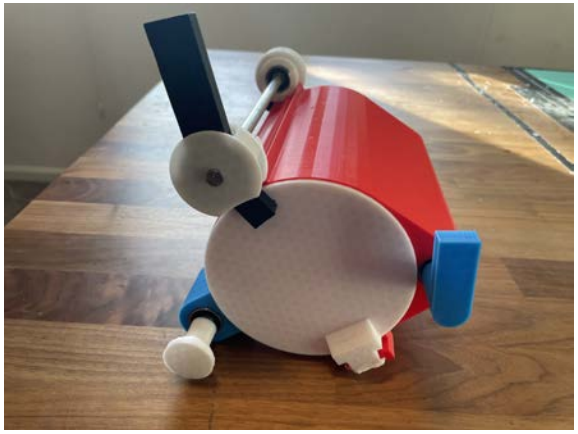
Colby Mawhorter

Xavier O’Keefe

Ashton Sager

SPACE BEANS

(SPACE Based Ejector of All Non-usable Stuff)



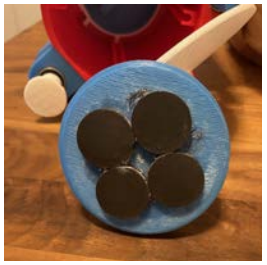
Chatfield Senior High HUNCH Program

Contact: Joel Bertelsen
(jbertels@jeffco.k12.co.us)

Load

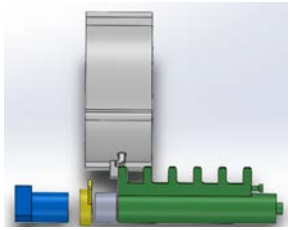
To load the device, astronauts will open the inner hatch, pull back the cartridge, and lock it in place at its innermost point.

Magnetic Handle
The cartridge handle can be screwed off to reveal magnets which hold the trash in place before firing and make it easier to load the trash.



The trash and handle can then be screwed back into the cartridge. The handle stops in a horizontal position.

Adjustable Firing
Finally, the handle can be held, and the adjustable launch system unlocked to adjust the firing power. There are currently three usable levels for this system. They are selected by rotating the blue handle to lock and unlock a set of green notches which hold the cartridge in place.

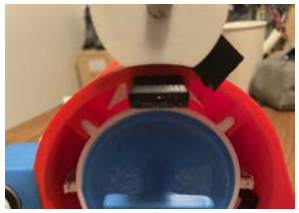


Lock

Rotation Locking System
This system prevents astronauts from opening both sides of the airlock at the same time. The system uses two offset wedges attached by a metal rod.

When the lever on the inside of the spacecraft is rotated, one side is unlocked and the other is locked tight using a wedge system on the end of the rod.

Rotation Obstructors
Two spring loaded rotation obstructors prevent rotation of the locking system unless both doors are closed.

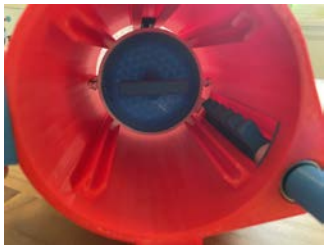


Air Removal
With both doors locked, the astronaut will activate a vacuum system to pump air out of the airlock for later use.

Launch

Exterior Door Manipulator
Before launching, the astronaut must open the exterior door by pulling on the handle shown in the bottom right corner. This opens the exterior door and can only be done when the exterior door is already unlocked.

Launching
With the adjustable launch system locked, the cartridge is held in place by a notch corresponding with the desired power.



When the blue handle on the spacecraft's interior is rotated, the cartridge is no longer prevented from moving forward and is propelled along by two springs attached to either side. This continues to accelerate the payload until it encounters a hard stop at the end of its track. Four notches on the cartridge lock into grooves on the airlock's interior, and keep the cartridge stable. They also stop the canister once the end of the track is reached.

Team Brochure

HUNCH TRASH EJECTOR

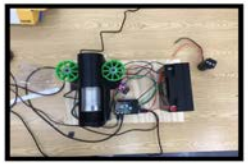
For more details about our prototype, visit our website: Spacesmiths Trash Ejector!

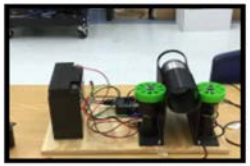
School: Sanger High School

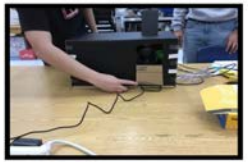
Teacher: Mrs. Garvis

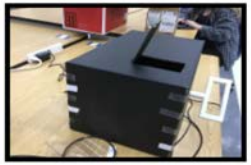
Team members: Joseph Phrachanhsay, Andy Vang, Mia Gallardo, Jesus Vargas

Description: In order to use the ejector first, you will need to know the weight of the trash that will eventually fill the can. You will open the top hatch of the ejector and place the can into the can holder. Then you'll type the weight of the can into the Raspberry Pi which allows the motors to spin to the optimal rpm. Finally, you will open the outside hatch and push the can pusher into the spinning wheels.

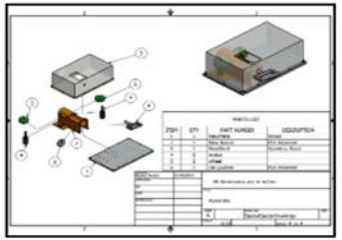




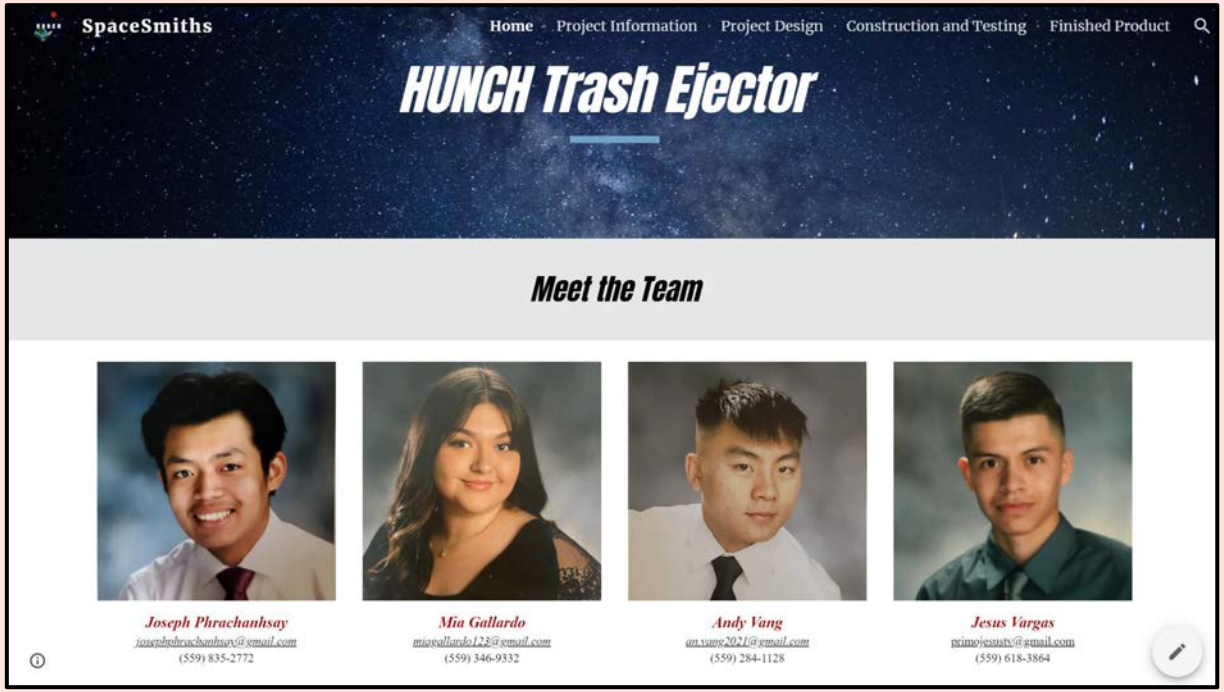




Final CAD Assembly:



Team Website



Above: Internal Hatch Opening and Trash Loading Area

Key Features of the Loading Area

- Dual Engagement Internal Hatch Lock
- Trash Storage Area to utilize otherwise wasted space
- Ability to bale trash, use a solid container, or bag
- Opening Handle
- Pronged Trash Holder with Detents to hold the Trash in place until ejection
- Flat Surface, easy to seal for a vacuum

About Us

About Us

Left to right: Dominic Patsy (UMD 2025), Roggen King (Vtech 2025) , Darrel Bossman (HCC 2025)

Contact Us

Email:
ghshunchtrashejector@gmail.com

NASA TRASH EJECTOR
Glenelg High School, MD

NASA TRASH EJECTOR

Designed and Created by: Dominic Patsy, Roggen King, Darrel Bossman

Rear End of Trash Ejector

Exterior Components

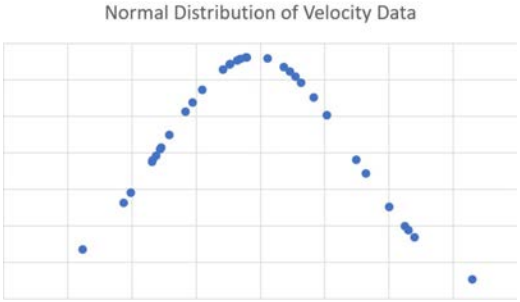
Handle and Rotation Guide

Located on the rear end of the trash ejector, is the handle used to crank the ejector back. The handle and lever are crafted out of a medium duty caulk gun. Also attached to the caulk gun are parts that create rotation for the trash as it is ejected. There is a 3D Printed Follower as well as groove which rotates the trash as it ejects. It is recommended to NASA to use a fast travel lead screw for maximum rotation.

Benefits to the Caulk Gun Design

1. It allows the spring to be compressed however much is needed to eject the trash
2. Locking Mechanism will hold the trash in place one the spring is compressed

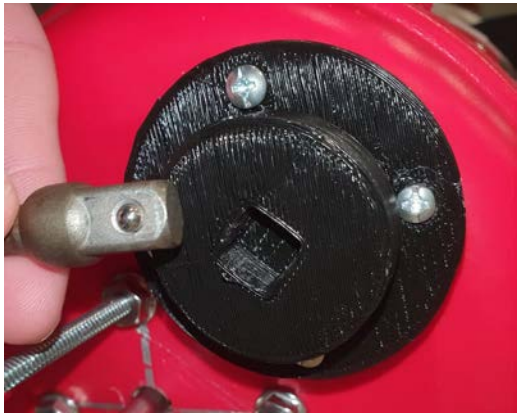
Variable Control



We derived an equation using Hooke's Law and Kinematics to estimate Trash Velocity based on weight of the trash and compression of the spring. We tested our equation and prototype, and after applying all the necessary criteria, we applied the Normal Distribution Model to our Ejector.

Accuracy and Consistency of our design

We have estimated that **95.5%** of all ejections using our prototype will occur within **+/-6%** of the predicted velocity, making this design the most accurate and consistent design possible.



Knob used to open exterior Hatch

Exterior Hatch Opening Knob

The Knob to open exterior includes a 3/8 inch drive for a ratchet, impact driver, or drill to allow for more convenient and faster opening

Other Important Features

1. Can be easily produced with off the shelf parts and low-cost production methods such as CNC Machining and 3D Printing

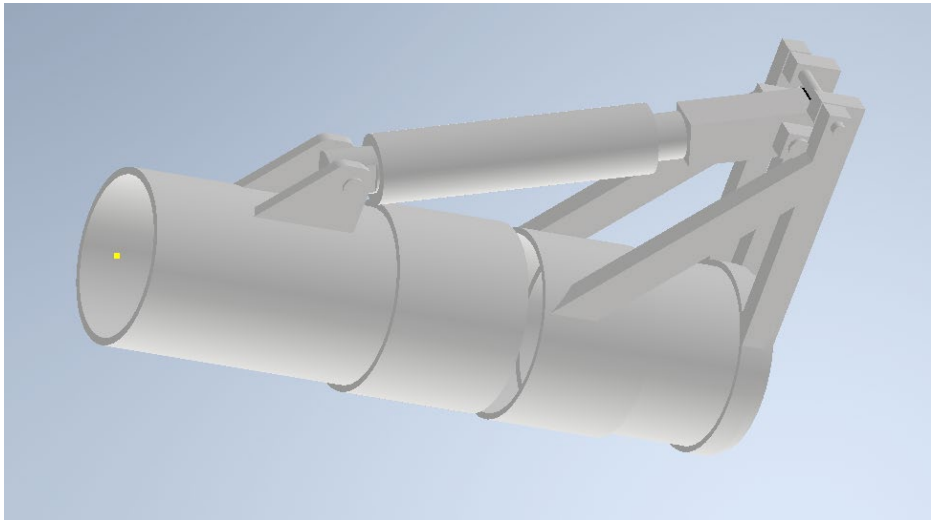
Recommendations to NASA

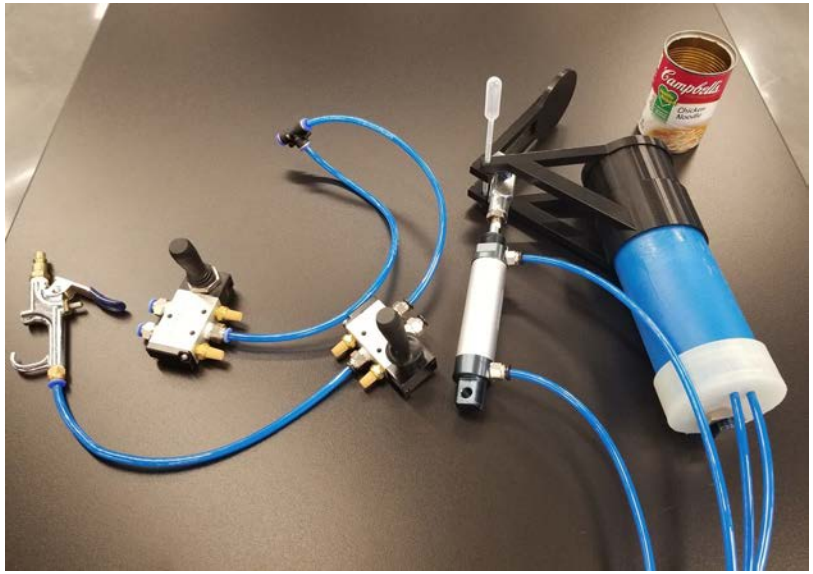
- Using a Fast Travel Lead screw for rotation
- Machining parts out of aluminum and titanium
- Viton O-Rings and Gaskets for vacuum sealant

Trash Ejector

Meridian Technology Center
Mrs. Short
Gage Allen, Sam Glenn, Wyatt Lopp, Seth Thibodeau

Our unique design features an air tight outer hatch which is operated by a piston. With the hatch open, garbage can then be ejected by a piston out into space. All of this can be done remotely through a system of two way valves and tubing, which allows us to easily adjust the pressure with which the trash is launched.




Campbell's

HUNCH Trash Ejector

Billings Career Center

Eric Anderson

Aristotle Malek, Jacob McCandless, Sean Meron

Our trash ejector prototype is an excellent choice for NASA to use on future spacecraft, ships and stations alike, due to its efficient and relatively simple design. Our model can eject waste with ease by simply placing waste canisters in through the side hatch, setting the spring slider, vacuuming out any air, and pulling and releasing the handle to launch waste out of the front.