Mars Vehicle Trash Ejector
Semi-Finalist List
for
NASA HUNCH
Design and Prototyping 2021

Congratulations for being chosen as a Semi-Finalist for NASA HUNCH Design and Prototype 2021. Your design was chosen as a semi-finalist because you have a prototype that shows some or all of your idea, interesting/original ideas in your design, you did some valuable testing, and/or had some CAD designs that conveyed significant contributions. Despite the difficulties and not as many schools participating this year, I believe that HUNCH has received as good of quality of projects as ever. You should be very proud of your prototypes and ideas especially because of the difficulties surrounding this school year. Some schools have been out of class all year and others have been in class all year but students were being pulled out of class for weeks at a time. Some students were only able to work and build from home. One school was only able to work together on their project for 3 weeks before their CDR. Everyone should be commended on your resilience to finish your project and the great ideas and work you have put together in front of your own eyes. Prototyping and testing are the first steps in any engineering project and all of you have learned the value of it.

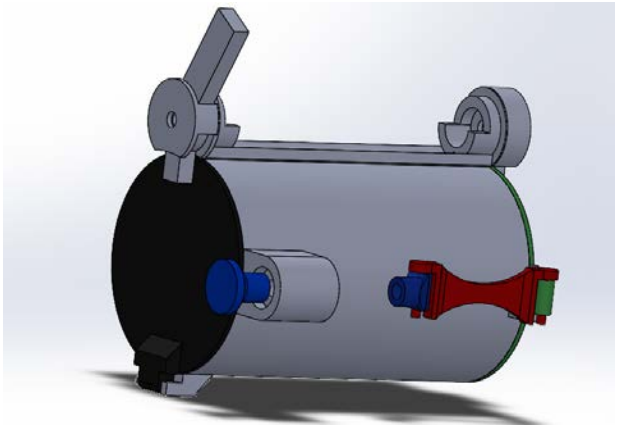
It is from the Semi-Finalist list that we will narrow down our choice for Finalists. We at HUNCH are very proud of how difficult you as students and teams have made it to choose which designs should go forward. **Congratulations!!!**

This list may be updated in the next day or two if we find we are missing a few team's brochures.

We expect to have the list for the Final Design Review in the next day or so as well.

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

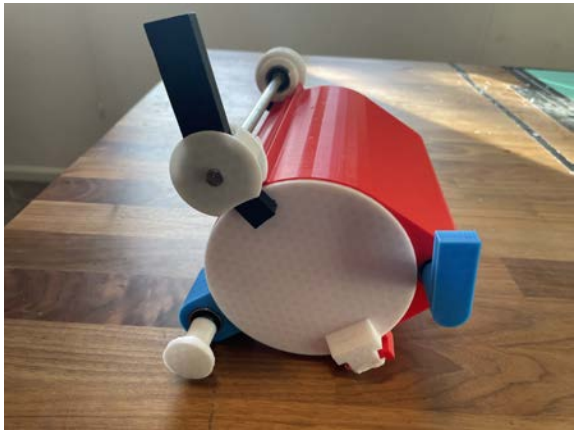
Colby Mawhorter

Xavier O’Keefe

Ashton Sager

SPACE BEANS

(SPACE Based Ejector of All Non-usable Stuff)



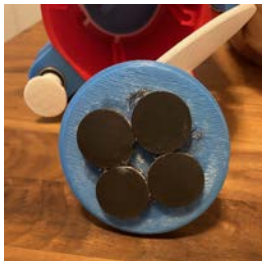
Chatfield Senior High HUNCH Program

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

Load

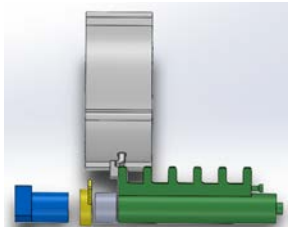
To load the device, astronauts will open the inner hatch, pull back the cartridge, and lock it in place at its innermost point.

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.

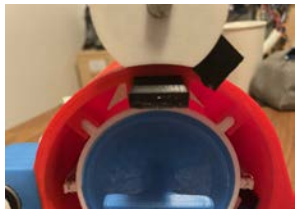


Lock

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.

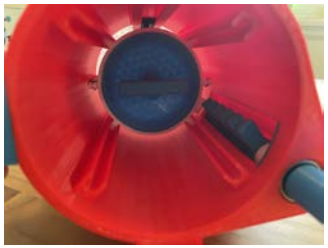


Air Removal
With both doors locked, the astronaut will activate a vacuum system to pump air out of the airlock for later use.

Launch

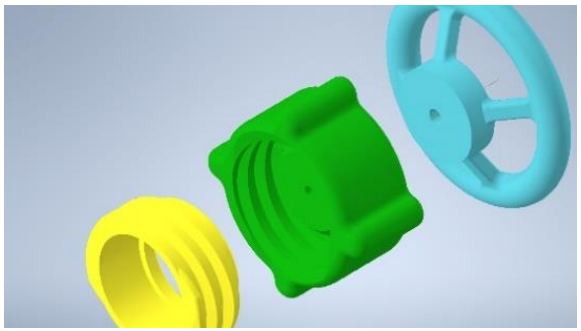
Exterior Door Manipulator
Before launching, the astronaut must open the exterior door by pulling on the handle shown in the bottom right corner. This opens the exterior door and can only be done when the exterior door is already unlocked.

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

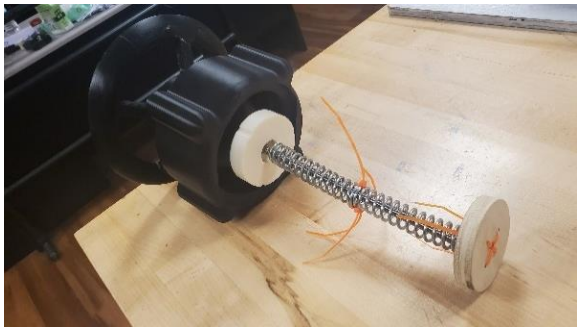


When the blue handle on the spacecraft's interior is rotated, the cartridge is no longer prevented from moving forward and is propelled along by two springs attached to either side. This continues to accelerate the payload until it encounters a hard stop at the end of its track. Four notches on the cartridge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

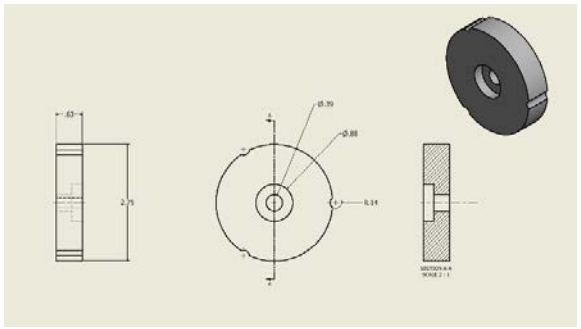
PICTURES



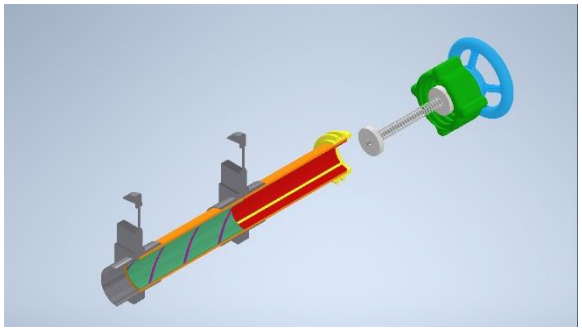
CAP THREADS AND HANDLE ASSEMBLY



FULLY CONSTRUCTED CAP AND PLPUNGER

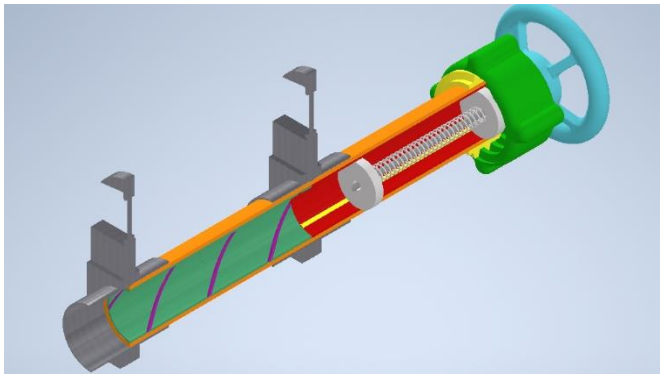


DIMENSIONED PLATE



FINAL INVENTOR FILE DESIGN ASSEMBLY

TRASH EJECTOR



By: Nathaniel Beasley, Melvin Briscoe IV, Isaak Salinas, and John Stambaugh

Clear Creek High School

2305 East Main Street, League City, TX 77573

Instructor: Mr. Merritt

School Phone: 281-284-1700

NASA HUNCH

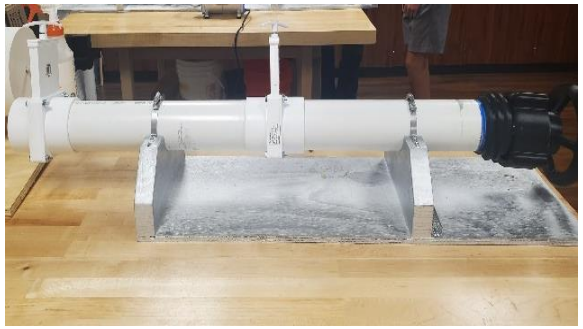
High school students United with NASA to Create Hardware

PROBLEM

On the way to Mars or any distant destination, the astronauts will be eating food, repairing the ship, and doing other activities that will accumulate trash. If they hold on to all the trash until they get to their destination it will take up much needed space as well as creating smells that can distract and harm the astronauts. Along with the loss of space, the extra mass will cost extra fuel to decelerate and safely land the spacecraft at their destination.

FINAL DESIGN OF EJECTOR

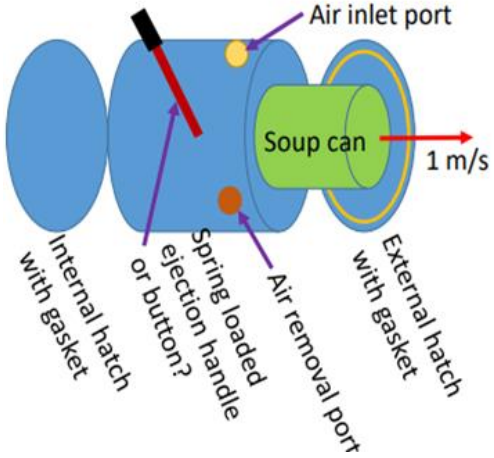
SIDE VIEW OF FINAL DESIGN

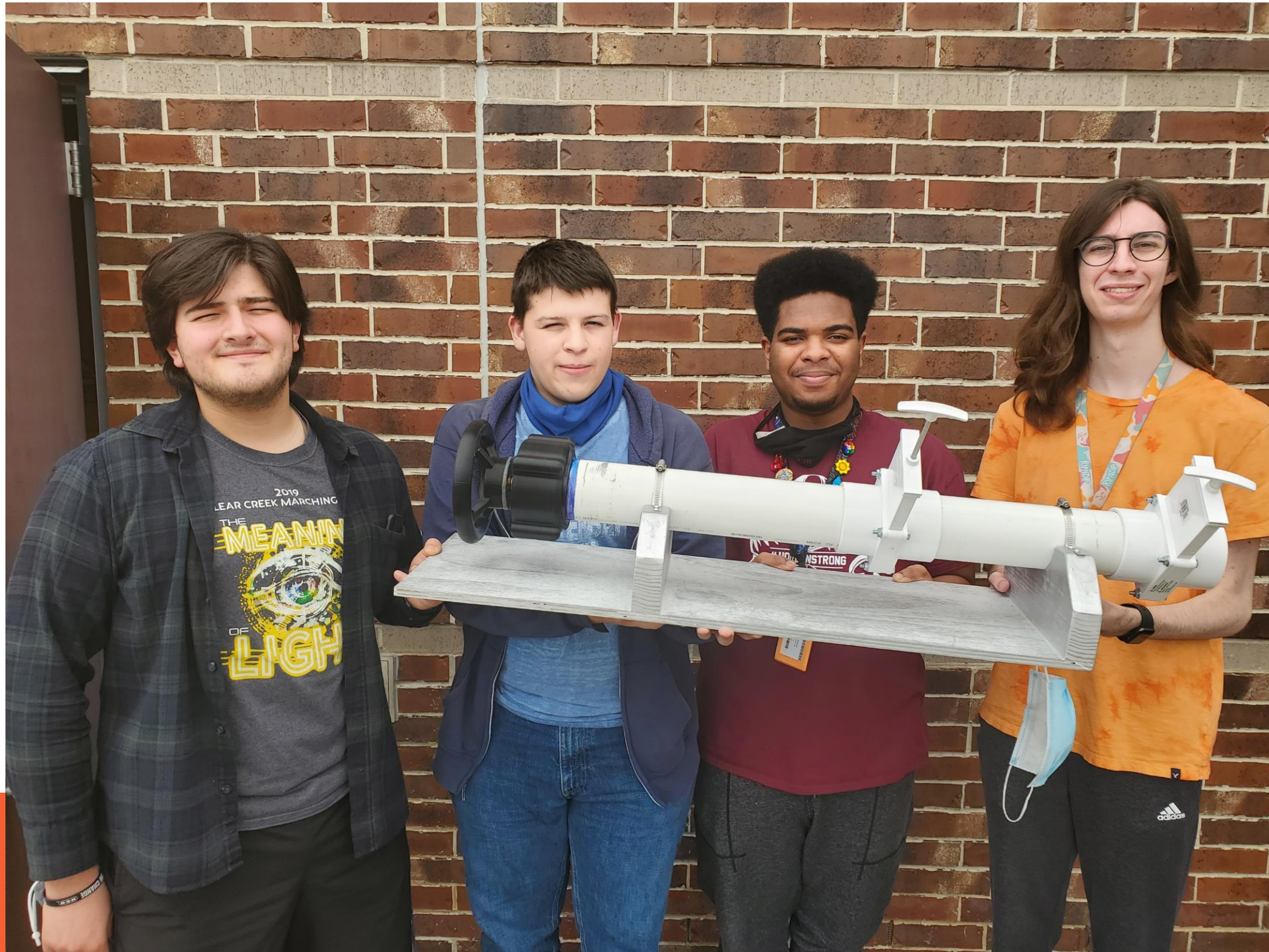


OBJECTIVE

Our objective is to reduce the fuel needed to slow the spacecraft down when arriving at Mars and Earth by ejecting projectiles that contain the trash accumulated by the astronauts along their journey. These projectiles must leave the spacecraft at around 1 m/s to ensure it does not collide with the spacecraft and must burn on entry to the Martian atmosphere. Our launch mechanism must also be able to launch multiple weights of projectiles at similar speeds and be easily repeatable.

DESIGN INSPIRATION



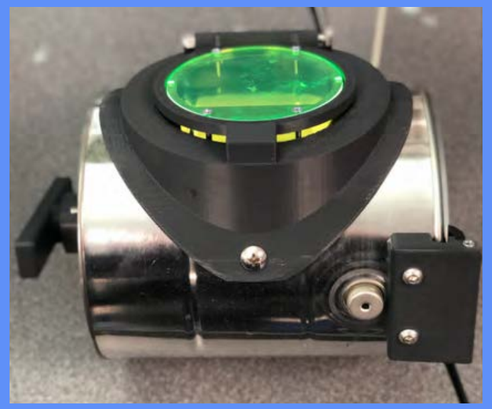

2019
LEAR CREEK MARCHING
THE
OF
adidas

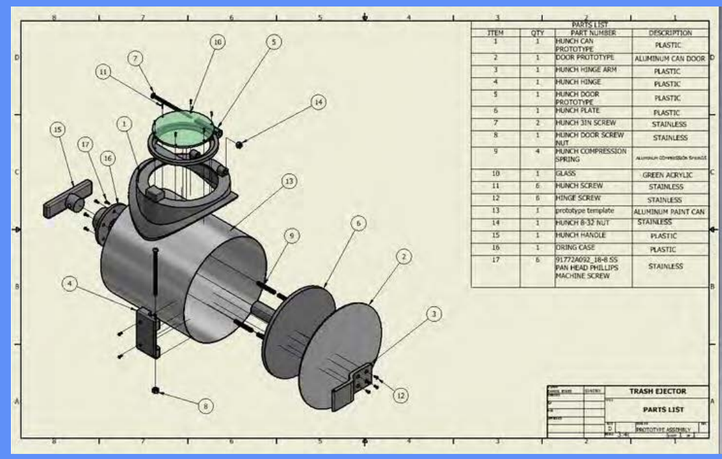
BRIDGELAND
HIGH SCHOOL

DANIEL JONES, JORDAN ALANIS, TYLER MILLER
MR. LAUGHLIN

What is it?

This is a paint can that we converted to use a system with springs and a push plate to complete its goal of launching our unwanted trash out into space. It features an internal, top loading system for the operator to input the trash.





NASA HUNCH TRASH EJECTOR

Mars Trash Ejector

School:

Cherokee Trail High School

Teacher:

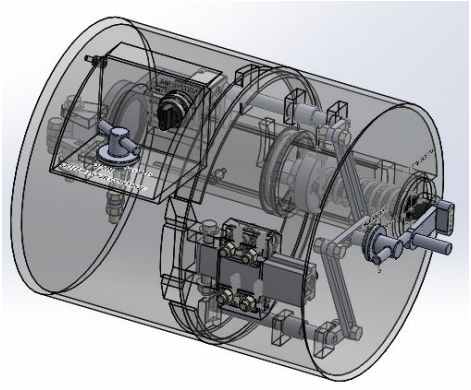
Ben Nuebel

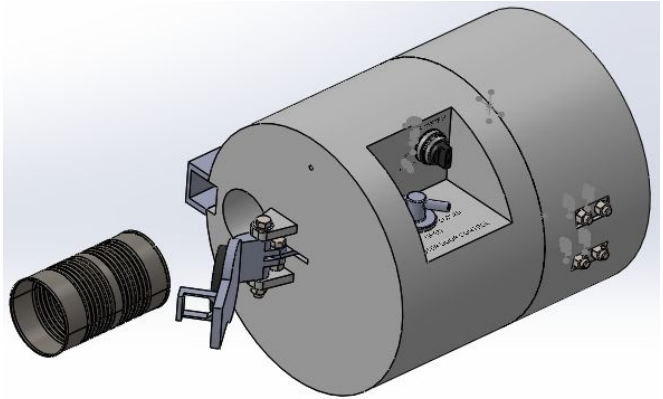
Students:

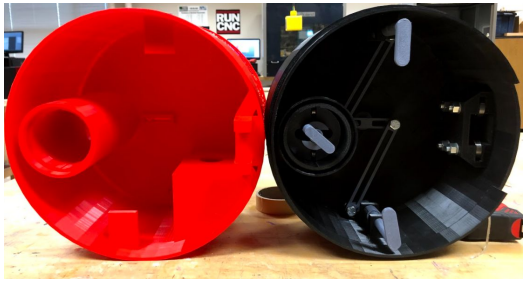
Austin Weske, Landon Woodman

Description

The Mars trash ejector can contain and launch a can of soup into space. It locks the can into place and the inside door so air can't escape. When it's launched the outer door opens letting the can into space then locking back up. The Ejector is smooth on the outside with a lot of mechanical and moving parts on the inside.







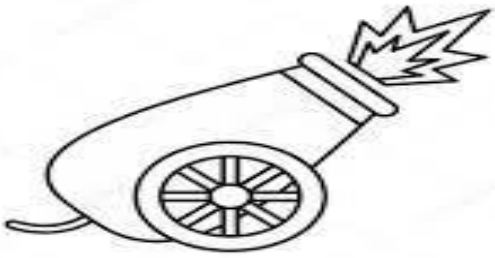
Matthew Ashworth and Kyler Holland

Chatfield Senior High School Hunch Program
Contact: Joel Bertelson jbertels@jeffco.k12.co.us

TrashForMars

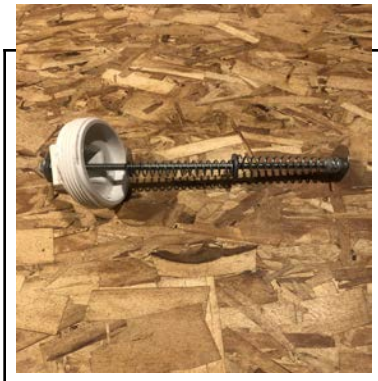
Problem Statement

The trip to mars will accumulate a lot of waste. Since the spaceship would not be allowed to stop, there needs to be a way to get rid of the trash while the spaceship is still moving. One problem would be figuring out the technology to transfer the waste from inside the spaceship to space. Also, finding a mechanism to shoot 5kg, 10kg, and 20 kg of waste. The trash should not be faster then 1 m/s when exiting the spaceship. There also needs to be a way to remove all the oxygen before the waste is removed.



Prototype

On the left we have a torpedo like design that will allow for easy access to the firing chamber. On the right there is a latching mechanism to separate space and the craft until ready to fire



On the left is demonstrating the spring powered launching system responsible for launching. On the Right is the release mechanism that allows the springs to be loaded mechanically then fired.

This demonstrates the loading

mechanism that primes the springs for firing

Test Results

We tested all different lengths 3 times each, and found a rage of...

- Pulled back 4 inches, an empty soap can 0.64 m/s-0.75 m/s
- Pulled back 6 inches, an empty soap can 1.11 m/s-1.34 m/s
- Pulled back 8 inches, full soap can .68 m/s-.81 m/s

As far as testing goes, most of our launches met the criteria for the project, but we can use different methods to try and make each launch more constant. Such as trying our rope, with other materials.

Moving Forward

Moving forward our group does have a lot to consider to get our project ready for the mission at hand. Some of our ideas include...

- Drilling a hole in the left side to place a reversible vacuum. The vacuum can such out all the air before launch, but can also release air back in.
- Shorting the hand wrench inorder to make more room, by using a metal rod to use as a wall. The wall will allow our rope to form a 90 degree angle and still be able to pull the spring back, while shorting the length of our projects.
- Testing different materials for the rope, to decrease friction and make our launches more consistent.
- Using a lever mechanism to open the outside door instead of the pulley system. This will cause a more reliable and consistent opening.

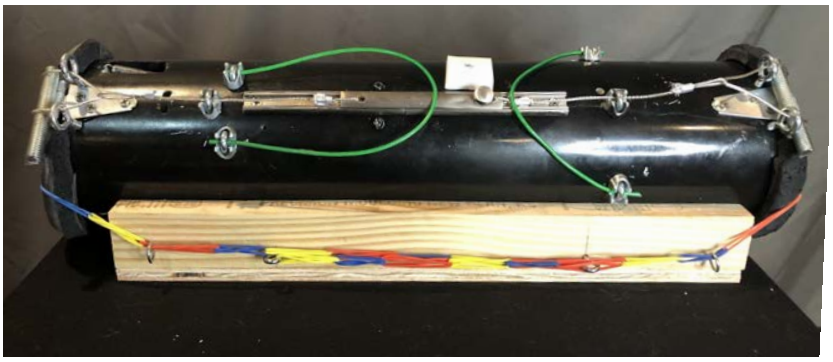
Jeremy Felker & Spencer Kauffman
Chatfield Senior High School
Contact: Joel Bertelsen
Email: jbertels@jeffco.k12.co.us

SPRITE

Spring Powered Rotating Interplanetary Trash Ejector

Problem Statement

As NASA and other space teams prepare for their eventual voyage to Mars, it must be considered that trash is a major concern, as a small space can be uncomfortable to live in due smell, sight, or space usage. As a result, spacecraft designers and engineers must look for ways to effectively eject waste into space to be burned in a planet's atmosphere (Earth or Mars) that also consider aspects of the mission such as fuel consumption, space management in the spacecraft, and traveler safety.



System Components

Our trash ejector comprises five different components that all act in a specific way to ensure success. They include:

1. Base
2. Trash Ejector Shell
3. Hatch System
4. Loading System
5. Launch System

Component Overview

Base - Made entirely out of wood, this provides a surface that allows for operation in a classroom or presentation setting on earth.

Shell - Made entirely out of PVC pipe, this proves the shape of the trash ejector and is rigid to allow forceful movements.

Hatch System - Using light wood, toilet gaskets, elastics, pvc wires, a door latch, and other essential hardware, this system is responsible for the opening and closing of the interior and exterior hatches.

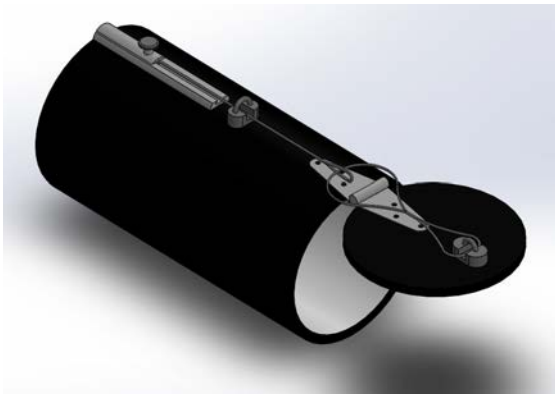
Loading System - Using two CAD-designed 3D printed parts, allows for the insertion and removal of the trash from the interior of the spacecraft while still allowing for an effective launch of the trash.

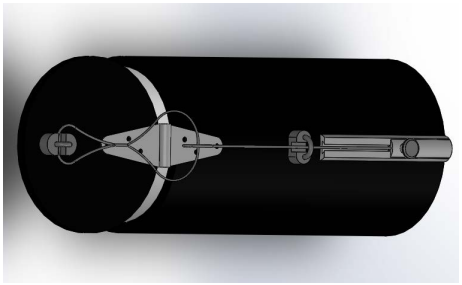
Launch System - Comprising extension springs, a PVC launch stopper, and a custom designed launch pin, controls the launch of the trash ejector and the trajectory that follows.

Highlights

Hatch System

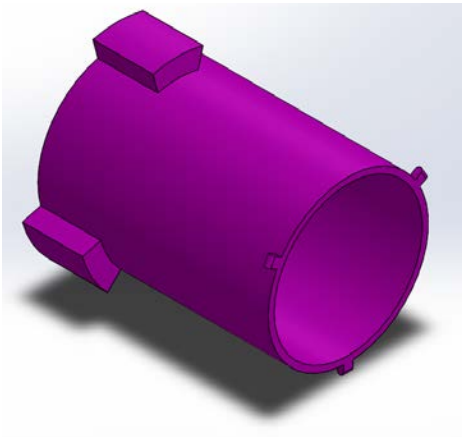
- Comprises a sliding latch, 1/16 in wire clamps, 1/16 in diameter pvc covered wires, small gate hinges, 4.5 in diameter wood hatches, and rubber bands (not pictured)
- Sliding latch and wire allow for opening and closing of one hatch at a time
    - When the wire is moved forward, it bends and doesn't affect hatch
- Rubber bands keep hatches closed and airtight alongside use of gaskets

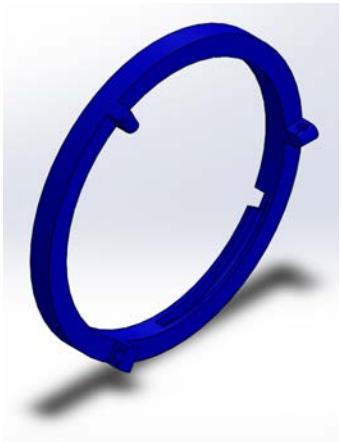




Loading System

- Comprises two components to work together to secure trash and allow for pull-back launch
- Launch connector (blue) has a track along the inside to guide launch canister's (purple) pins and secure connection of the canister and springs
- Launch connector is connected to three extension springs to create forward propulsion when pulled back





- Canister is inserted from the internal hatch, slid up to the font, and then twisted into the launch connector

Testing

Speed Test

- In order to meet the NASA requirements for this project, we had to keep the speed of the can under 1 m/s
- To test the speed, we completed 5 launches and calculated the average distance from a launch height of 88 cm
- Average horizontal distance came out to be 42 cm
- Using knowledge of calculus and physics, we can derive an equation to find the time of the launch which was 0.424 s
- That can be used to calculate the average speed which is 0.991 m/s
- Note: this test was based on a unfilled soda can
    - Heavier weights will move slower, so empty launch sets an upper bound to possible speed of ejector

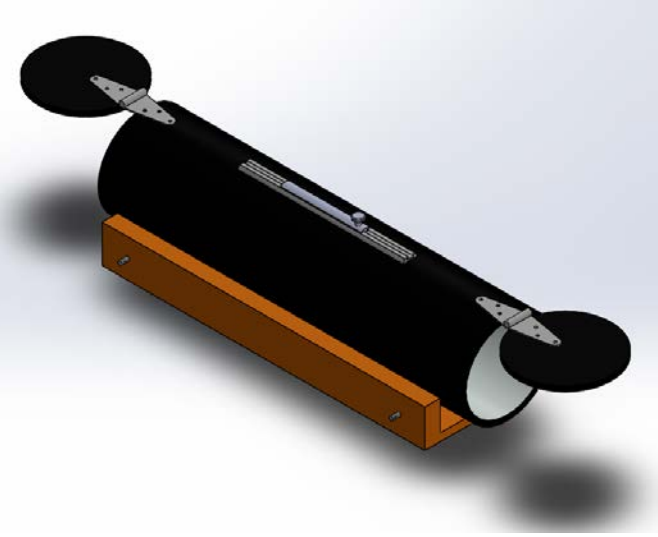
Load Test

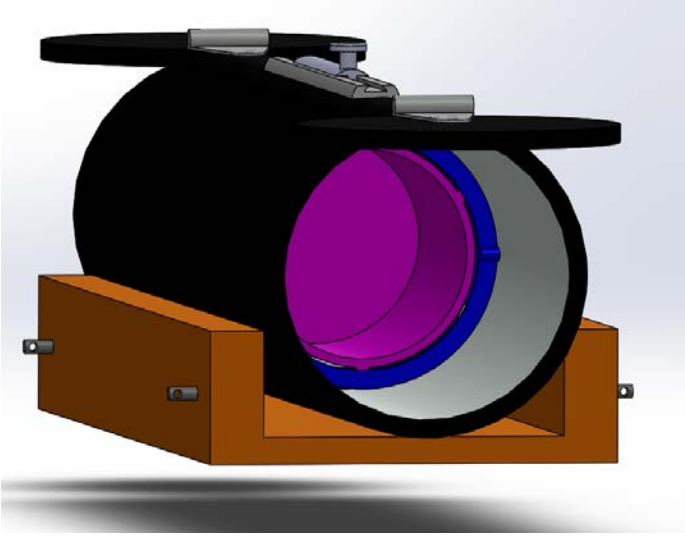
- Another crucial component to our trash ejector was the loading and unloading of the launch canister into the trash ejector and launch connector
- This test was completed by timing the insertion of the launch canister 10 times and then finding the average based on that
- Average time came out to be 18.03 s
- This time is not as fast as desired and should be looked into when considering the next iteration of the project
- There should also be reconsideration of the design of the shell as many fasteners were used that interfered with the insertion process

General Tests

- Launch test
    - As the trash ejector has not failed to launch in this stage of the iteration, the trash ejector has a 100% successful rate of launch
    - Despite the rate, sometimes the launch is not straight and may benefit from a more streamlined shell design
- Hatch test
    - Despite appearing functional, the hatches are still somewhat difficult to use, as the metal bars used to help propulsion can be undone easily
    - When looking a potential redesign of this aspect, a cohesive design between the edges and the metal bar would be recommended

Full CAD Drawings

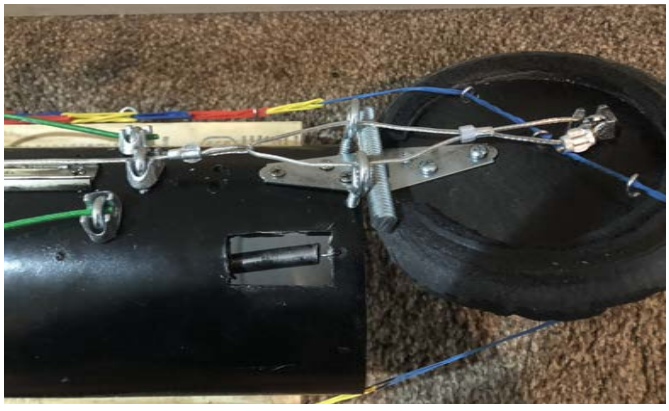




Additional Close Up Photos

Interior without launch canister

Interior with launch canister

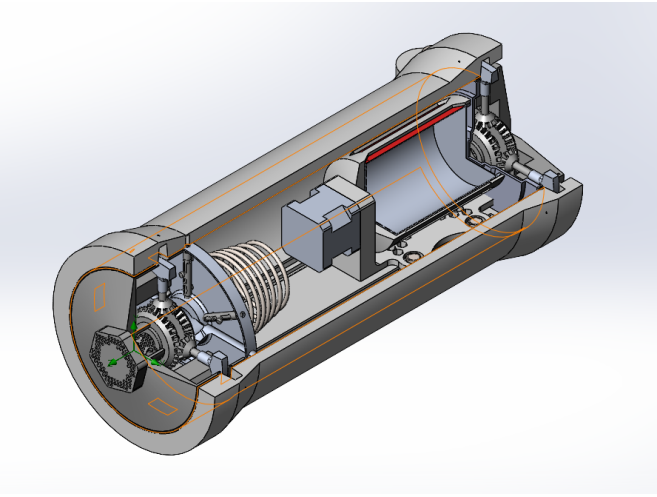


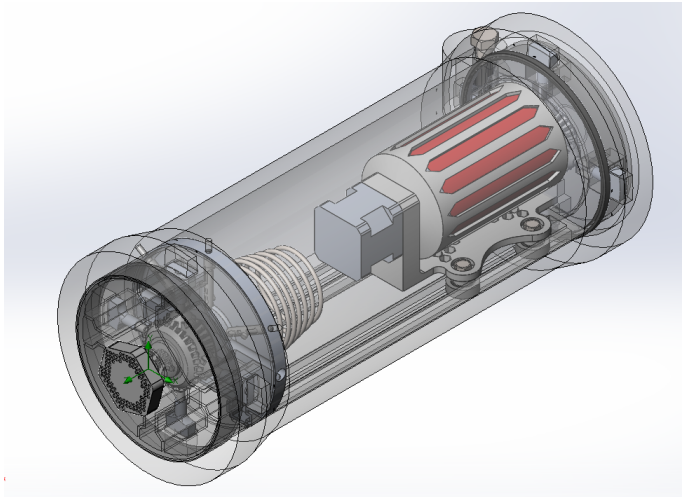
External hatch system

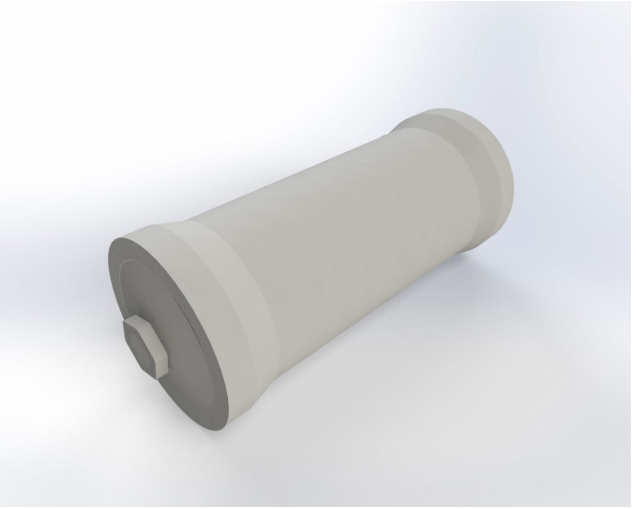
MARS TRASH EJECTOR

ZACHARY FITZJARRELL - CHEROKEE TRAIL HIGH SCHOOL (TEACHER - BENJAMIN NUEBEL)

THE MARS TRASH EJECTOR THAT I CREATED WORKS IN A SMALL, COMPACT, AND EFFICIENT DESIGN. THE SOROBAN GK EVER THAT IS USED WITHIN THE MODEL IS USED TO COMPRESS THE SPINE , BADSHA DON A SET AMOUNT OF DISTANCE, TO ESTABLISH THE AMOUNT OF FORCE REQUIRED TO PRINCE THE ACCELERATION FOR THE OBJECT IN THE HOUSING. THE STEPPER MOTOR ROTATES THE TRASH AROUND TO ENSURE THAT IT STAYS ON TRAJECTORY FOR AS LONG AS POSSIBLE. THE DOOR IS SIMILAR TO A BEVEL GEAR DESIGN TO HELP REDUCE BOTH STRESS, STRAIN, NOISE, AND DAMAGE ON THE GEARS. BOTH THE FRONT AND THE BACK USE THE SAME GEARS TO ESTABLISH A UNIVERSAL FIX FOR BOTH THE FRONT AND REAR. FINALLY, THE ELECTRONICS ARE CONTROLLED BY AN ARDUBNIO AND 12V DC CURRENT.







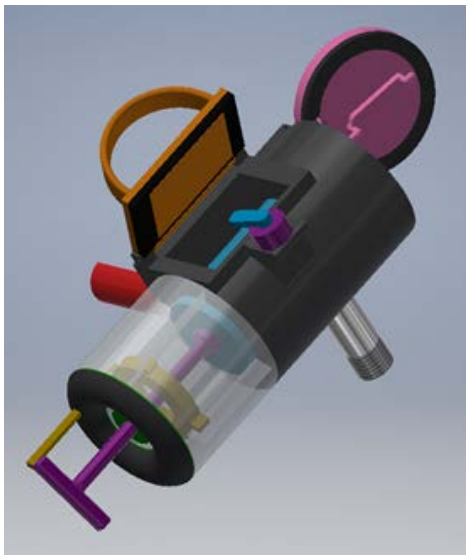
HUNCH Trash Ejector

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.



Continuing Work

We are researching and looking into refining the spring mechanism to enhance durability while maintaining necessary ejection forces.

Outside Research Sites

American Astronautical Society (AAS)

https://astronautical.org/

National Aeronautics and Space Administration (NASA)

https://www.nasa.gov/

SpaceX

https://www.spacex.com/

About Team TED

We are a group of students at Clear Creek High School who want to pursue engineering as a profession.

Team TED consists of
Ty Crouch
Hunter Jones
Dennis Kostjuhin Ethan Le
and Jessica Metzinger

Contact Team TED

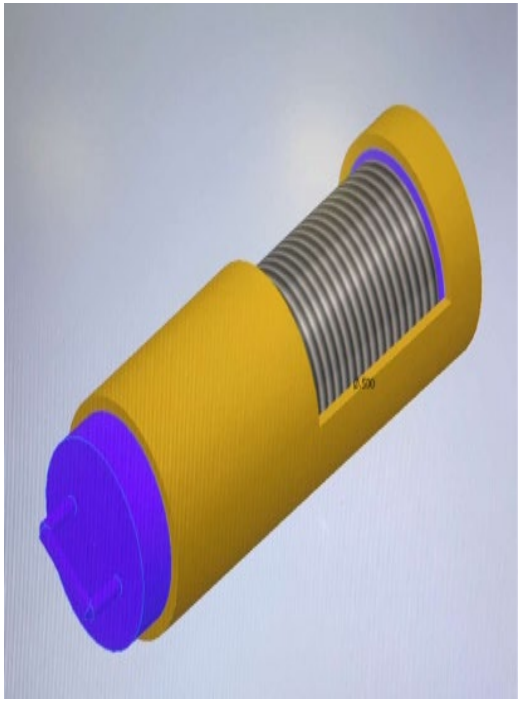
Advisor: Ms. Elizabeth McCarty

2305 East Main Street

League City, Texas 77573

Phone: (281) 284-1700

Email: emccarty@ccisd.net



MEET TED: A TRASH EJECTION DEVICE

A NASA 2021 Hunch Project

Our Project

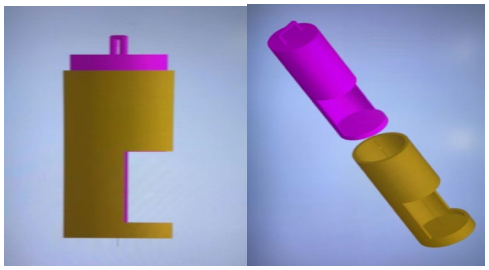
***Background*:** On a daily basis, it is estimated that one Astronaut generates 2 cubic feet of trash per day. The trash is stored and eventually hauled away on supply vehicles.

***Problem*:** The current system works for short trips. The upcoming trip to Mars will involve 18 months of travel and the astronauts must be able to dispose of trash on their journey. It is not practical or safe to travel to Mars with a spacecraft full of garbage.

***Solution*:** Our team has developed a solution that we call "TED" short for a Trash Ejection Device. TED will eject trash from the spacecraft no faster than 1 m/s towards Mars and burn up in Mars' atmosphere.

Our Design

***Simple Design*:** Our design consists of a cylindrical shape that has an inner drawer inside of it. This allows us to keep a seal from the outside atmosphere while also being able to move the inner drawer and insert trash to be ejected.



Inner drawer inside & separated

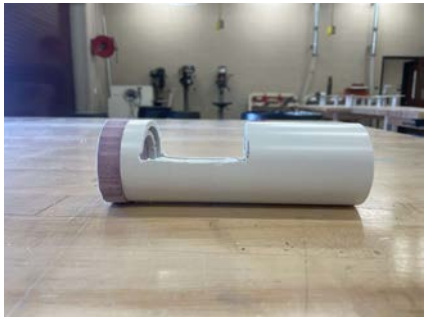
TED Works – The 4E's

***Ergonomics*:** Insert trash into the loading area (inner shell) and push the drawer forward into its larger shell.

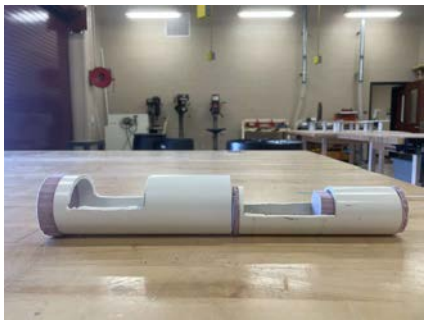
***Ease of Manufacture*:** Everything except the spring is 3D printed, and the spring is a standardized part that is readily available.

***Economics*:** It costs less than $100 (approx. $20-$30) to make our system because the entire thing except the spring is 3D printed.

***Endless Durability*:** The only component that could potentially need replacing would be the spring, a 30 second fix.



Shell with Inner Drawer Inside



Shell with Inner Drawer Outside

Top Down of Shell with Inner Drawer Outside

Materials

Prototype Materials

4 In PVC pipe
6 In PVC pipe
4 in to 6 in PVC adapter
3" Gate valve
Pressure gauges

Finished Product Materials

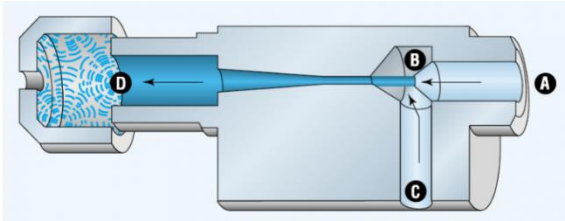
Aluminum Alloy 6061

Yield strength: (Metric)276 MPa, (English) 40000 psi
Modulus of Elasticity: (Metric)68.9 GPa, (English)10000 ksi
Thermal conductivity: (Metric)167 W/m-K, (English)1160 BTU-in/hr- ft²-°F
Melting point: (Metric)582 - 652°C , (English)1080 - 1205°F
Electrical resistivity: 3.99 x 10-6 ohm-cm
Hardness (Brinell): 95
Machinability: Good
6061 will be used for the all the other parts besides the barrel.

Steel

Will be used for the barrel of the Shooter.

Background Knowledge



IMAGES

POOP SHOOTER

By Linnea Swanson
Emily Davidson
Blake Matthijetz
Ricardo Estrada

Instructor: Robin Merritt

Clear Creek High School

Clear Creek ISD

League City, Texas

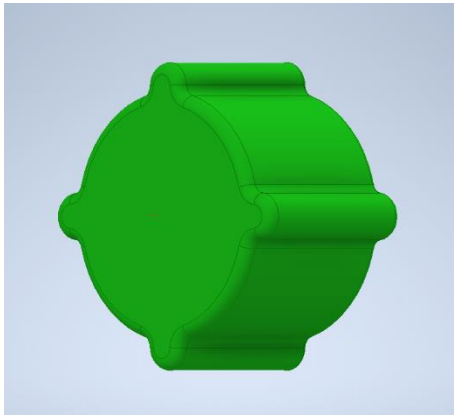
The Project

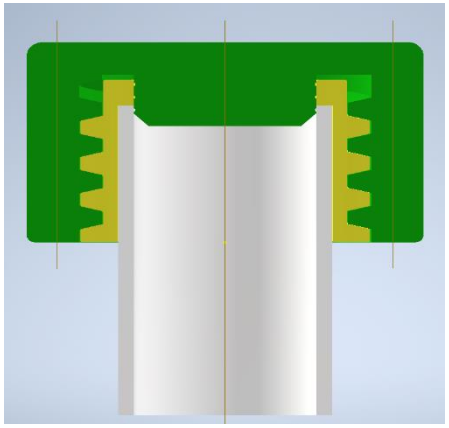
Purpose

This project is designed to launch waste from the space station into space so it can burn up in the atmosphere.

How Does It Work

To remove waste as intended, it uses a valve system and vacuum. The black side of the device represents the vacuum of space, and the white side represents the space vehicle. The vacuum creates a pressure difference of 20 pounds with 10 on one side and -10 on the other side. When the valve is opened, the depressurized environment causes the waste pod to shoot out.





The Finished Prototype

Loading Chamber with Hatches and Pressure Plate

The external hatch is pictured in the upper left corner. It can be inserted and exerted to allow the soup can to exit into outer space.

The loading chamber is directly attached to the solenoid valve. The chamber has two hatches. The internal hatch, also known as the loading hatch, is where we insert the soup can. Inside the hatch is our pressure plate. These are the two “cups” on the right side. They each have a gasket printed out of ninjaflex adhered to the bottom to create a seal. Only one belongs in the hatch. The internal hatch is also sealed to prevent air loss.

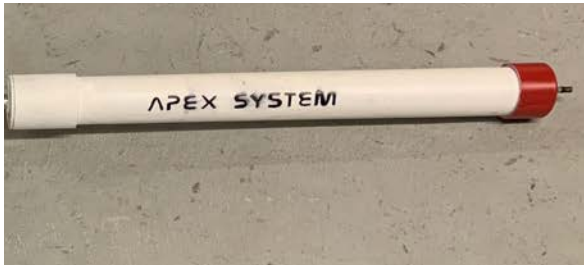
Pressure Gauge, Solenoid Valve, and Switch

A pressure gauge relays the psi of the compression chamber to the operator. The solenoid releases all of the air into the launching chamber at once when the switch is flipped.

Here on Earth, the solenoid valve acts as our firing mechanism. In space, it's as simple as opening a hatch. The solenoid becomes non-existent as the air will travel from higher pressures to the lower vacuum pressure of space automatically.

Air Compression Chamber

The compression chamber holds air and can be filled with either a pump or compressor to the desired PSI for launch.



In space, This chamber can be consolidated into the air spring behind the pressure plate, decreasing size and complexity of the part. The entire pressure system is a single compartment controlled by the movement of air within the spring.

Why Pneumatic?

In outer space, astronauts create waste, which takes up valuable space and causes odor; therefore, they need to eject the trash.

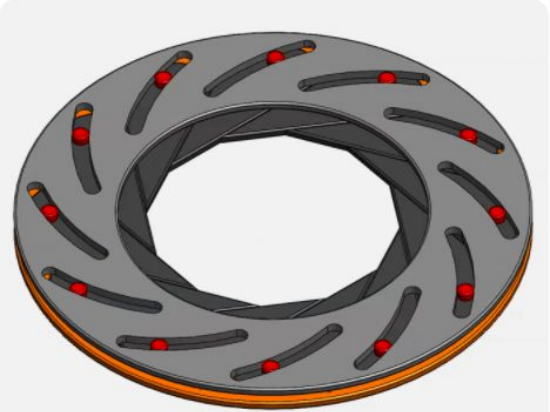
A pneumatic device is the most effective method of doing this because:

- It can measure the pressure built in the air compression chamber, allowing the operator to control the velocity of ejection with regards to the mass of the trash canister. A different psi is used for varying masses.
- Pneumatic systems are more consistent over time.
- APEX may require new air locks for maintenance; this is less than what would be required of spring-loaded systems.

Testing:

Although we acknowledge that required pressures will change once in outer space, we were able to launch a full soup can (260 grams) at 1 m/s with a pressure of 30 psi. To launch an empty soup can, only 15 psi were required. In summary, it takes about 10 psi for each 100 grams of waste you wish to launch.

Outer Hatch (Aperture)



Using the same concept as a camera shutter, this could be an outer hatch that serves two purposes: Releasing the trash, and catching the launch plate so it can be reused all the way to Mars.

APEX

Automatic Pressurized Expulsion System

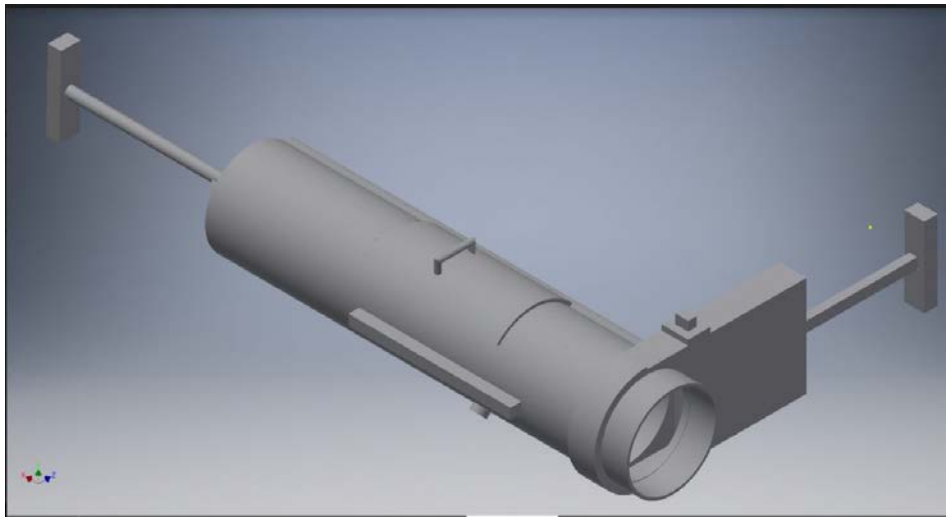
Jacob Brown
Ariana Elze
Mino Elze
Cooper Kern

Chatfield Senior High School
HUNCH Program

Instructor: Joel Bertelsen
Contact: jbertels@jeffco.k12.co.us

BILLINGS
CAREER CENTER

Trash Ejector
2020-2021



School - **Billings Career Center**

Teacher - **Eric Anderson**

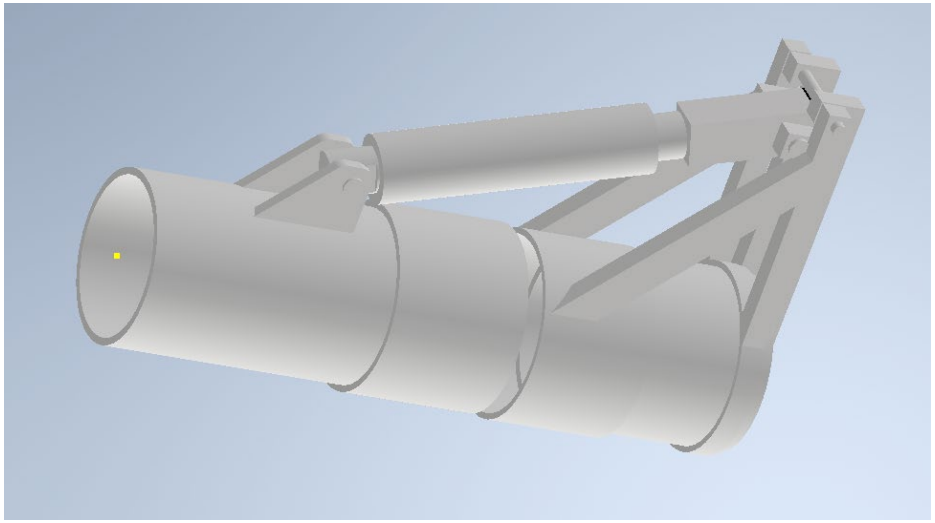
List of Students - **Nathaniel Lindberg, Jabari Cowee, Brennen Wilson**

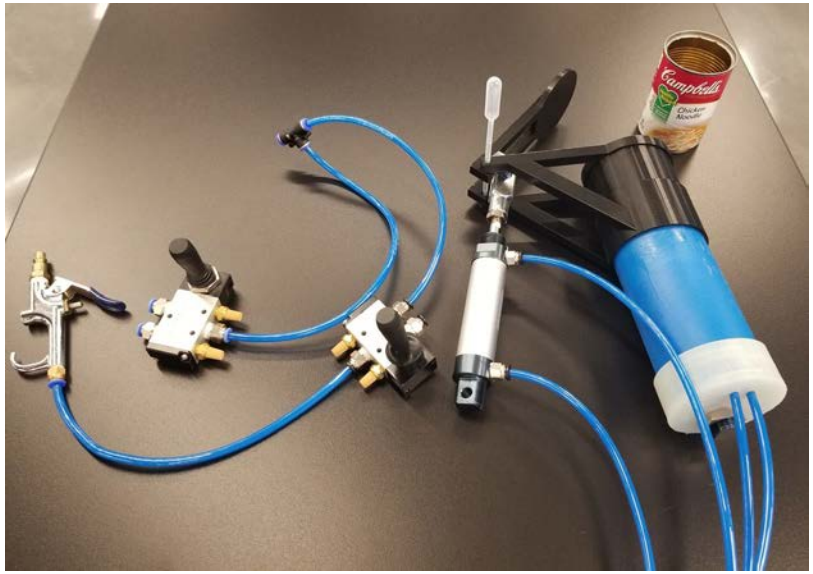
Description - **This trash ejector is perfect for the Mars mission because it is efficient, accurate, and is able to remove the garbage with the bear minimum simplicity. As well as equipped with an airtight mechanism to safely launch the trash.**

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

Problem

There is not enough room to store the trash for the trip there and back.

Solution

We made a chamber to put trash into, close with a cover, then eject out the other side.

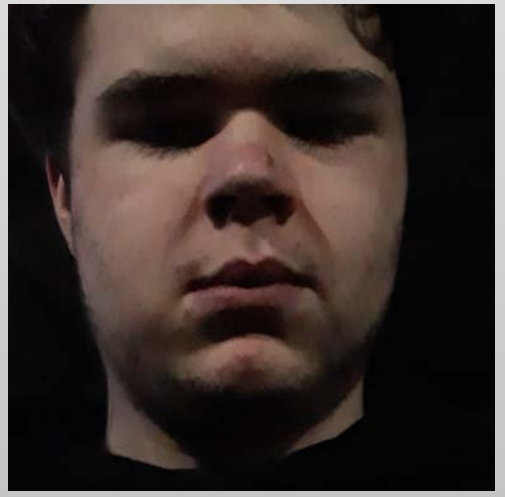
Saint John Valley Technology Center

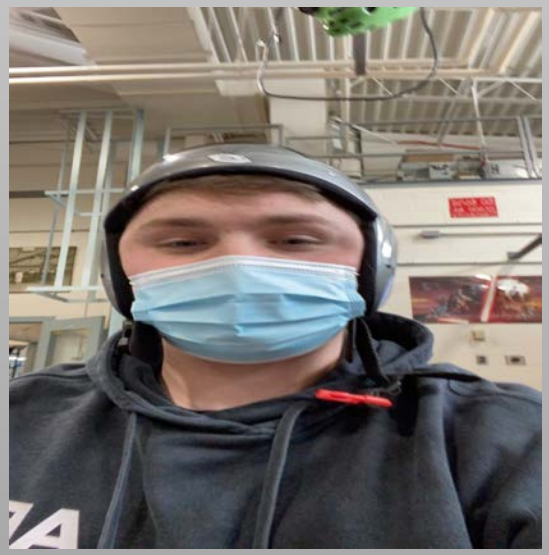
Frenchville, ME

Image taken from http://sjvtc.mainecte.org/

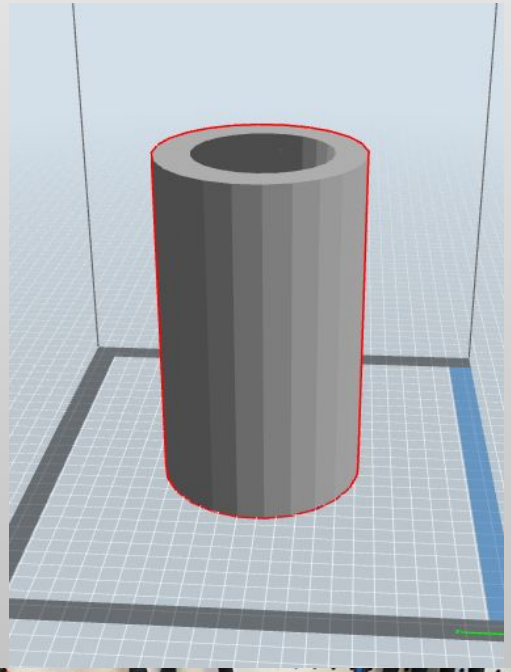
Trash Ejector

Owen Sirois, Jack Michaud
Mitch Daigle

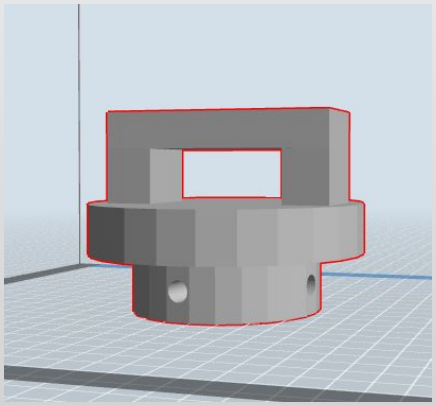


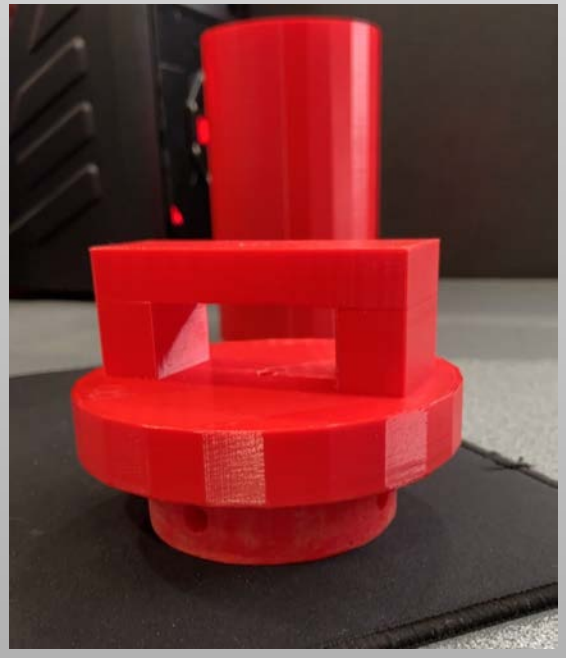


3d model and print of trash chamber

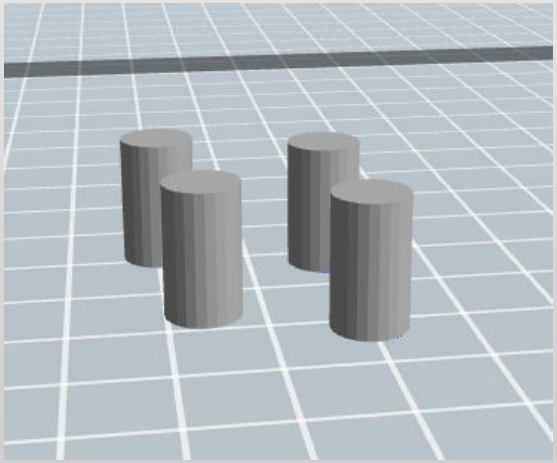


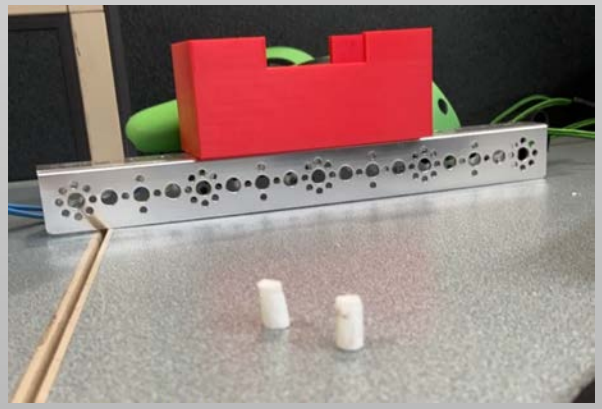
3d model and print of trash cover





3d model and print of pins





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)

Space Management

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

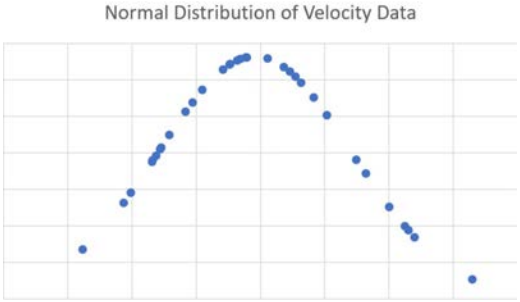
Handle and Rotation Guide

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

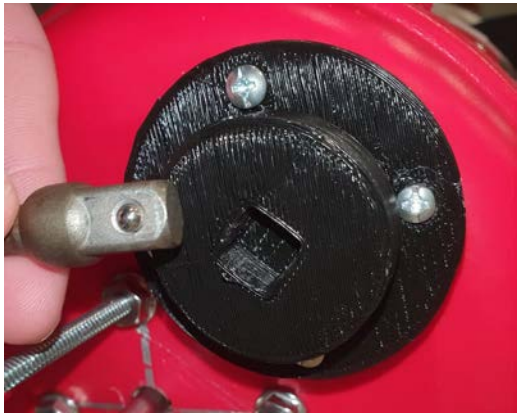
Variable Control



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

NASA HUNCH

High school students United with NASA to Create Hardware

BRIDGELAND HIGHSCHOOL

Teacher: Mr. Laughlin

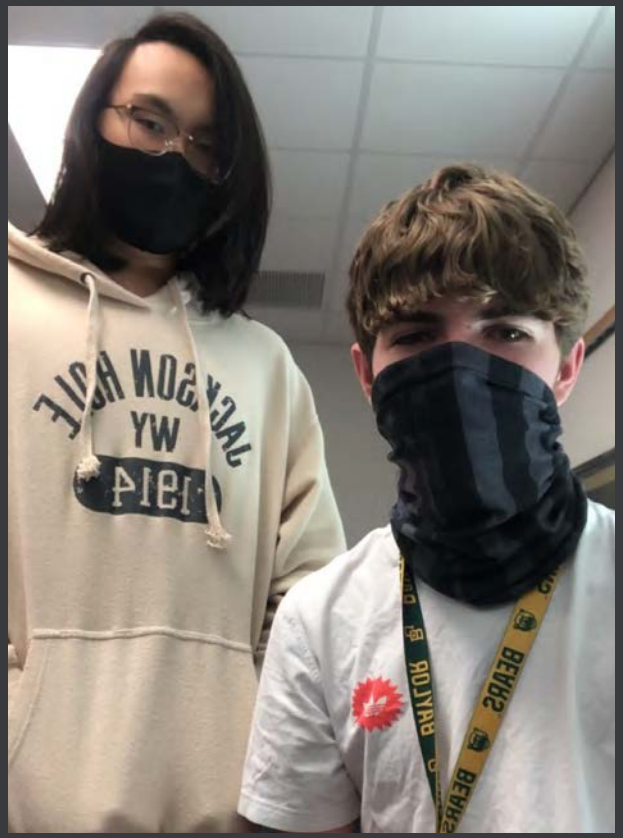
10707 Mason Road

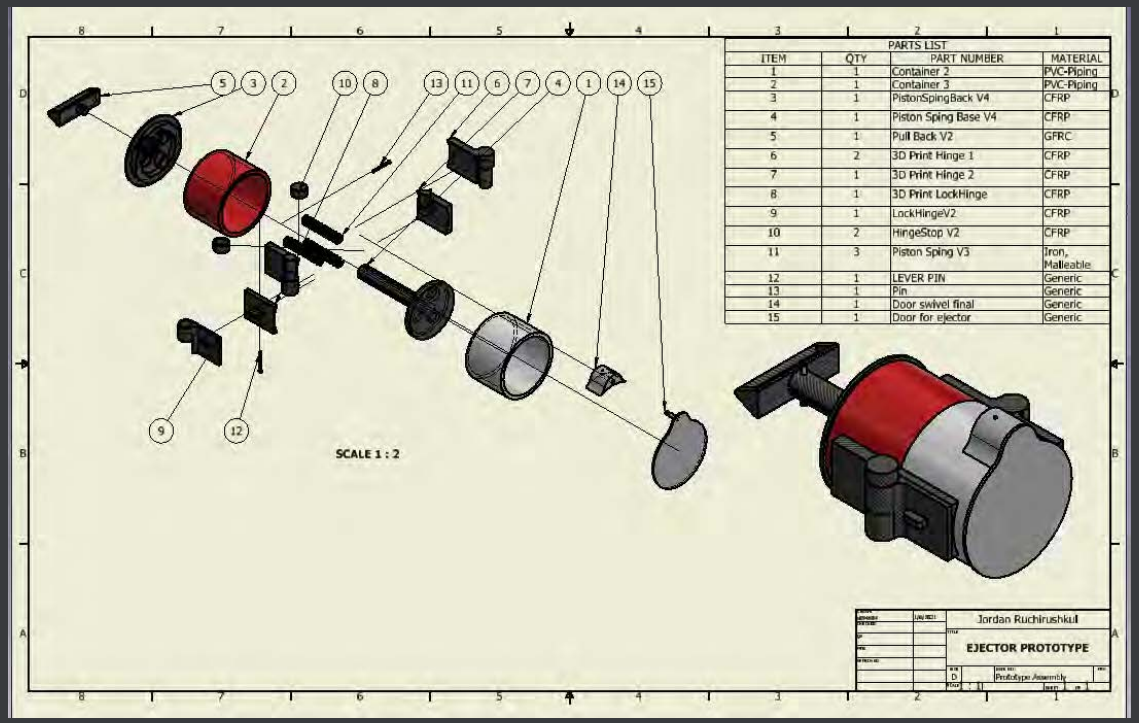
Cypress, TX

77433

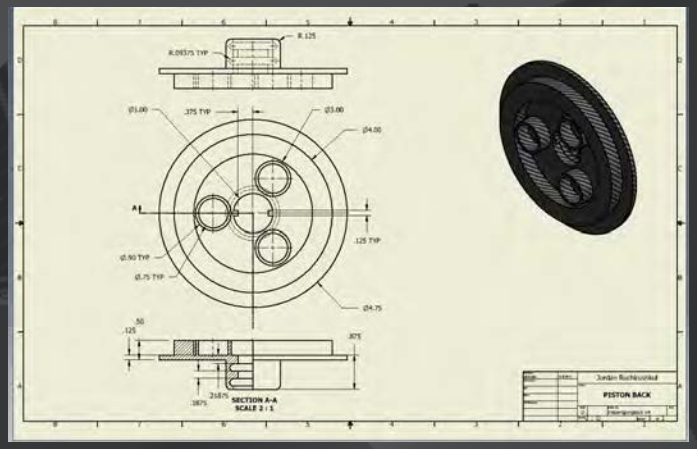
TRASH TUBE

PIPING THAT BE ATTACHED TO THE WALL OF A SPACE CRAFT AND USED TO LAUCHED SOUP CAN TYPE WASTE OUT THE SHIP.

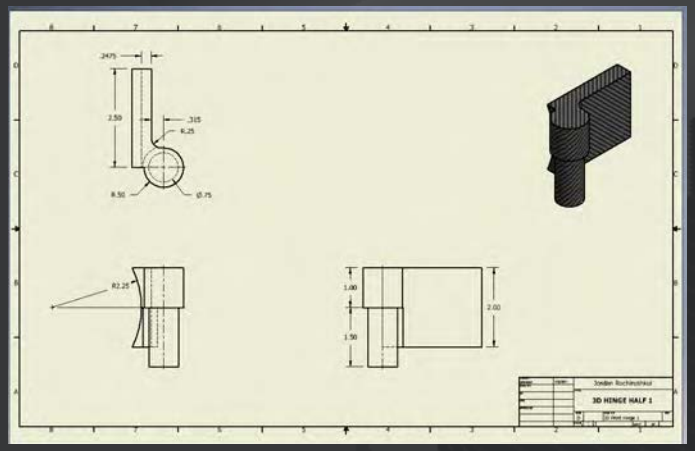




CAD DRAWINGS



-



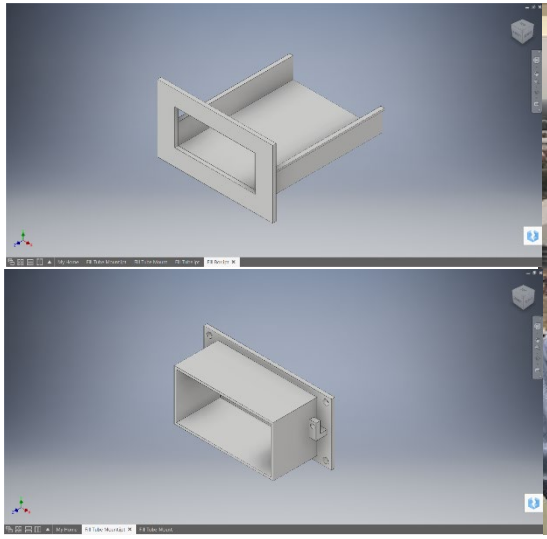
JORDAN RUCHIRUSHKUL

BLAKE TIMMERMAN

AIDAN SKELLY

-

NASA HUNCH MARS TRASH EJECTOR



Trash Dispenser

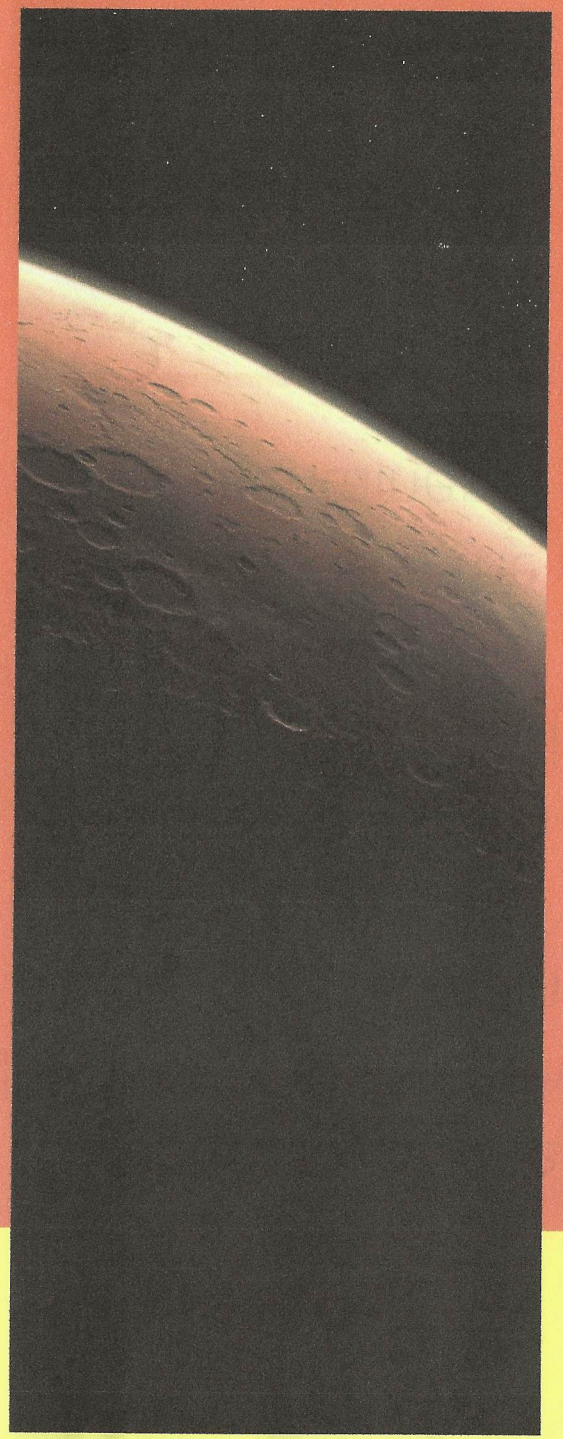
By: Chase Manns and Kane Dacier

School: Warhill High School

Teacher: Christy Bennet

Students: Chase Manns and Kane Dacier

Description: Trash is a major issue on the space station and let alone for future missions. Our design includes a cartridge. You will fill the cartridge and place it on the door rails of the cartridge mount. You will then push it towards the mount on the side wall of the station. Once the cartridge is pushed forward, the airlock pressurizes to the vacuum of space. When the pressure is equal, the trash is pushed out.



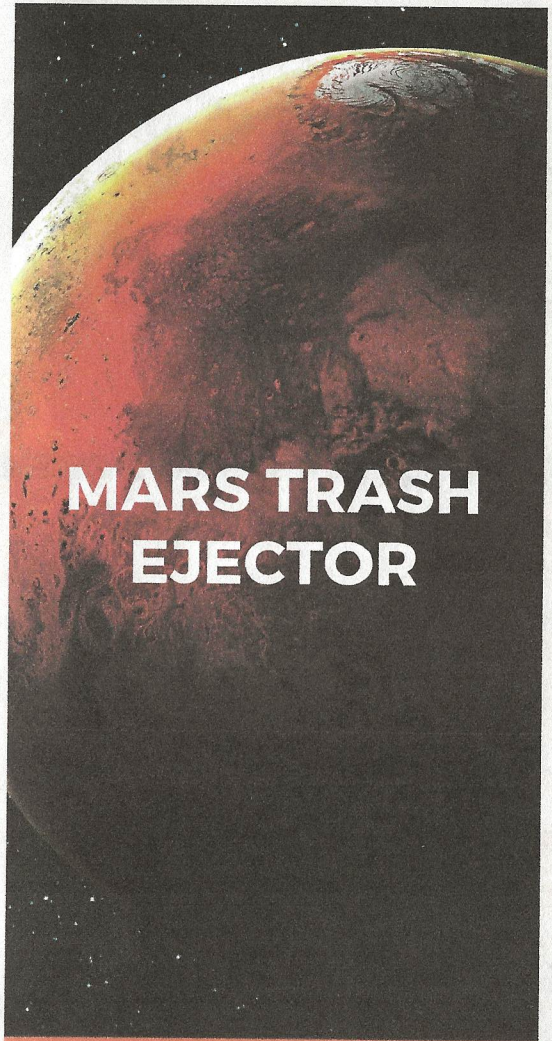
Team Members:

Shane Johnson

Matthew Rubis

Cypress Woods High School

NASA HUNCH

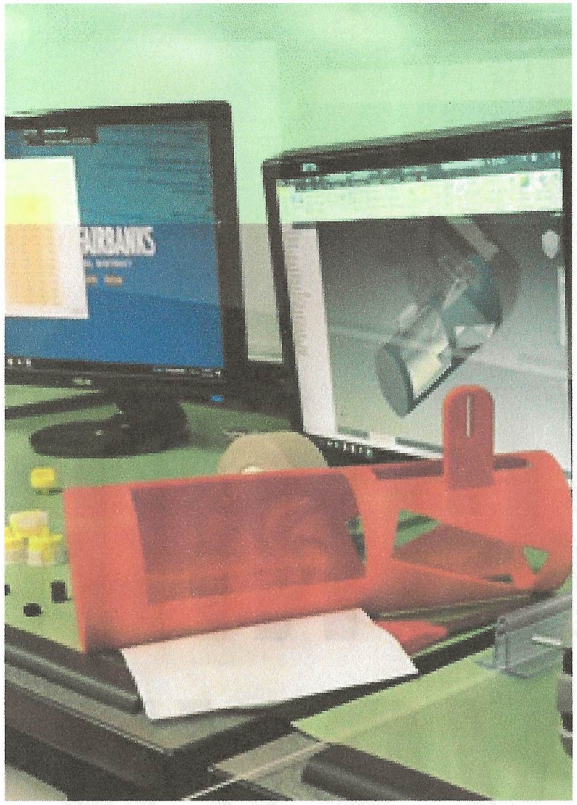


MARS TRASH EJECTOR

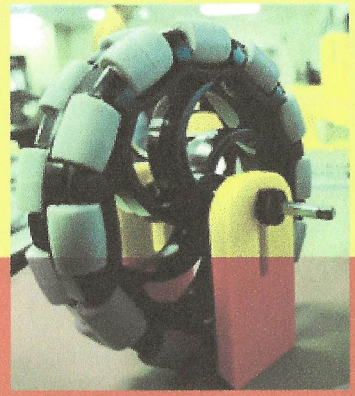
SHANE JOHNSON &
MATTHEW RUBIS

Mars Trash Ejector

Designed by Shane Johnson and Matthew Rubis, it has 3 main parts which work together to launch trash. The first part is the body or tube, which houses the trash containers.



The next main part is the launching mechanism which consists of 4 wheel, 2 omnidirectional and 2 normal flat wheels that all serve to provide forward momentum as well as some clockwise rotation to insure an accurate launch.



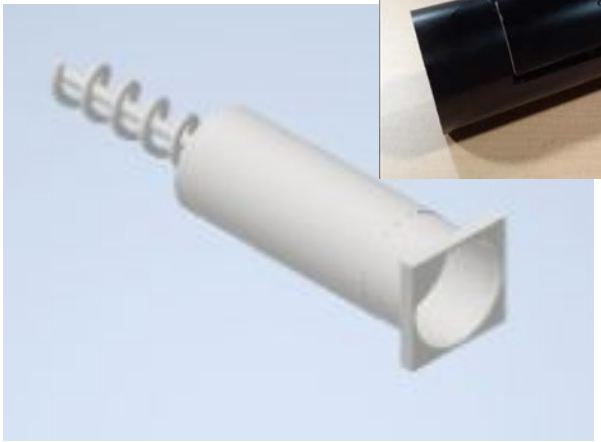
The third part of the trash ejector is the motor, controller and battery, which allows the powering and control over the 2 flat wheels, generating forward movement.

FRONT PAGE

MARS TRASH EJECTOR

By: Mike Sanchez, Mickenzie Fazenbaker

Trash Ejector: Manvel High School EDD students have been assigned to design a mars trash ejector by NASA Hunch. This will be implemented on a space shuttle to mars and accommodate for 6 crew members as well as fuel conservation.



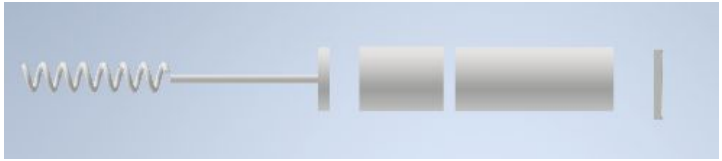
Design and Engineering Concepts

Mechanical and Aeronautical Engineering is used for our trash ejector, since both are use for the spacecraft design, and safety measures.

The concepts we are investigating:

- Airlocks, to prevent air from leaving the spacecraft
- Propulsion, in order to eject the trash efficiently
- Spring and Applied Force, used in our trash ejector

BACKPAGE



Does our design meet requirements? Does it work?

- Our design meets required specifications as the design can hold up to 5 gallons of trash, can launch trash pod at 1m/s, and when scaled up can function aboard a spacecraft.
- Trash ejector can function even if hatch is open or close.

Specifics of Design (design specification)

Loads: The loads change in each launch of the trash ejector as each load will fill 5 gallons, however the mass of each launch will be different leading for the ejector to adapt for each load.

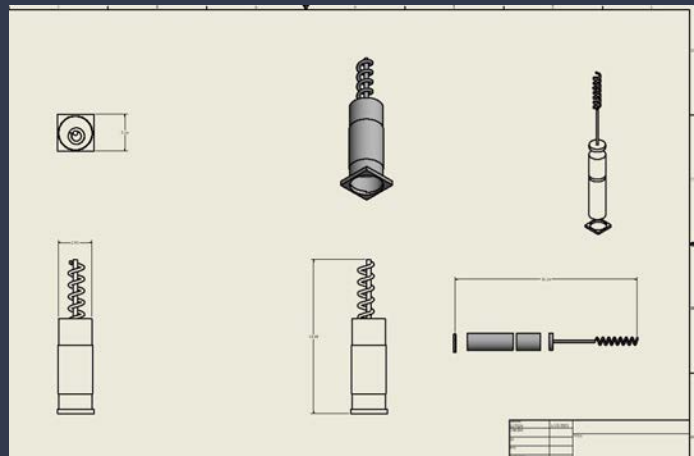
Materials: Materials like magnesium and stainless steel will be the primary building materials. The magnesium will construct the trash pod as it is strong and rigid but easily melted which makes it perfect for entering the mars atmosphere.

Mechanical Engineering: There will be mechanical engineering implemented in the form of the spring component of our design. It will also be included when the spring is pushed back to charge, some sort of mechanism will be needed for this action as well.

Energy: This trash ejector design will use mechanical energy in the form of kinetic and potential energy. The energy itself is not converted into anything but is built up using the spring mechanism to propel the trash pod forward.

Ethical Responsibility:

We meet the ethical responsibility as the trash ejector aids in the preservation of healthy crew members. The trash ejector ejects trash like poop, unwanted parts, and dirty objects that would otherwise pial up in the spacecraft and eventually lead to a spread of disease and sickness (possibly death) to the crew.



About the Project

The Mars Trash Ejector project is a project within the large Mars Colonization project where teams must research and create an ejector that launches unwanted waste that builds up during the journey to Mars from the spacecraft into Mars' atmosphere whilst preventing air from escaping the craft, risking the lives of those onboard, and excessively using vital resources.

Brought to you by:

The NASA HUNCH Program

Additional Information

Cypress Woods High School

13550 Woods-Spillane Blvd.
Cypress, TX 77439

Team Members

Brady Keating

Austin Ortiz

Brandon Chuong

Mars Trash Ejector

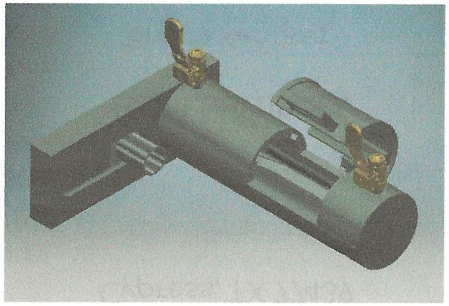
The go-to space ready gadget to rid your spacecraft of any unnecessary waste and materials

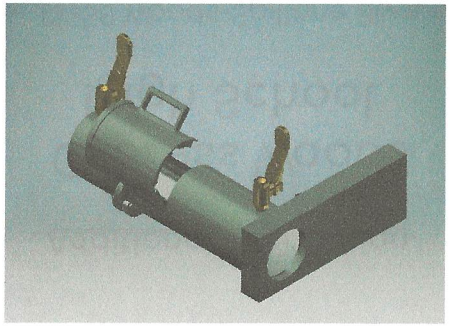
NASA HUNCH
High school students United with NASA to Create Hardware

How it works

Our ejector utilizes the power of air pressure and vacuums to launch the trash out of the spacecraft. Our ejector has holes on the top of the main body where valves can be placed and a vacuum can be connected to. These holes are where air can be vacuumed out and released into the main body. When trash is being ejected, the user will open the hatch, insert the trash, then close it. Next they would then open the valve and turn on a vacuum which will create a vacuum where the trash is located. The valve will then be closed and the outer door opened. When ready the user can then open the other valve allowing air from the cabin to rush in and push the plate forward and eject the trash. From here the user can close the outer door and the process repeats but the vacuum is created on the opposite side of the plate allowing it to reset.

Our Ejector





Prototype

The Dream Team

Kyler Williams, Tyson Bryant-Dawson, Josh Campbell, Christian Garnett

Component 0:

Our group, The Dream Team will be attacking the Mars Trash Ejector. We will be developing a scaled trash ejector for the Mars vehicle that will allow astronauts to dispose of their trash containers safely on their way to and from Mars. This project is away to keep the ISS and six astronauts clean and have the ability to have more space in the rocket.

Component 1

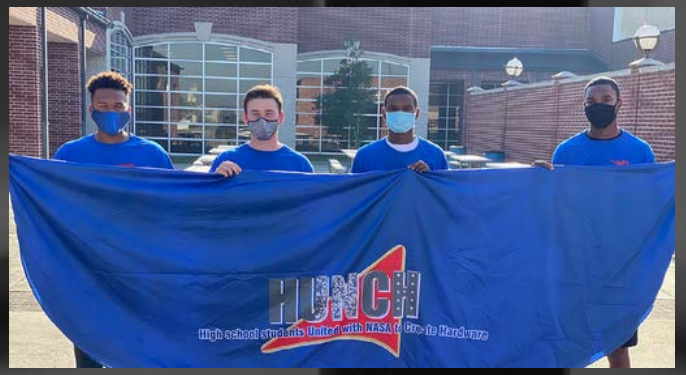
This element takes you through the initial steps of devising a problem statement for your team's project. The terms valid and justifiable mean the same thing to most people. Describing a problem as justifiable indicates that there is evidence that it is worth the expense and effort to attempt to solve the problem

Problem Statement:

NASA Hunch astronauts located on the international space station are in need of a way to get rid of trash efficiently. They have tasked Manvel High School EDD students with developing a trash ejector. Our group the dream team has created a profound prototype to solve the issue of this trash.

Component 2

Element D, was where we brainstorm, sketched, and build the product to present and reservice feed back from NASA. From the feed back we can and/ fix problem and improve on the product. The idea behind this product is to have the ability to be connected to the ISS spacecraft and eject trash and make room. These are somethings that are team thought would be useful. These items have rating from each one of us. The design process should be guided by the application and practices associated with Science, Technology, Engineering, and Mathematics or STEM. The designer(s) should accurately describe the relevant math and science concepts associated with the problem and solution. They should be able to use the data, calculations, and practices of these disciplines to drive the decision making process and defend their decision on important design goals.



Component 3

Component 3 was the building and prototyping phase where we used our sketches from component 2 and turned them into a 3D models using Microsoft Inventor. After we then started making a list of materials to make our prototype out of and then we started making the final product.

Cypress Springs High School

Industrial Technology

Engineering Design II

Cypress Fairbanks ISD

Cypress, Texas

NASA HUNCH PROGRAM

Name

Bryson Gomez

Instructor:

Steven Marcus

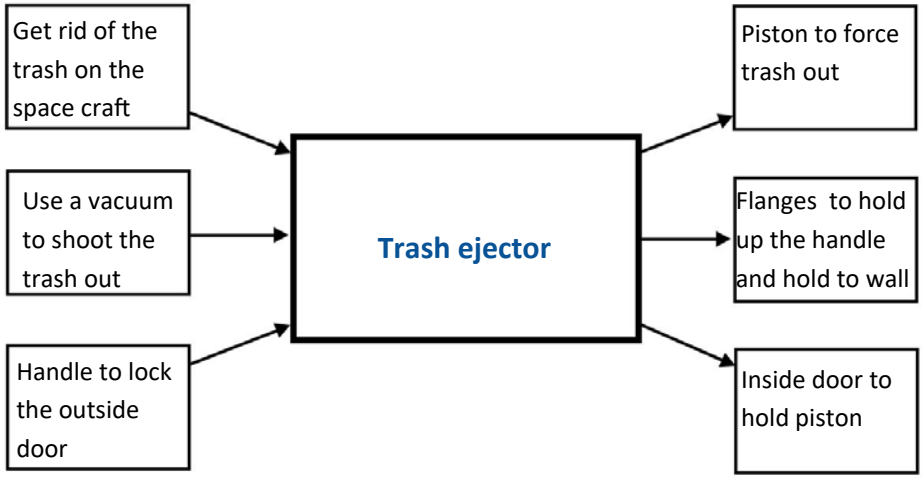
HUNCH Advisor/Mentor

Glen Johnson

Engineering Design II

Cypress Fairbanks ISD

Trash ejector



GENERAL INFORMATION:

To shoot trash out.

OBJECTIVES:

Not to have a lot of trash on the space craft

MATERIALS

Use plastic

SOLUTIONS

Re-done

PROBLEMS

To big or small

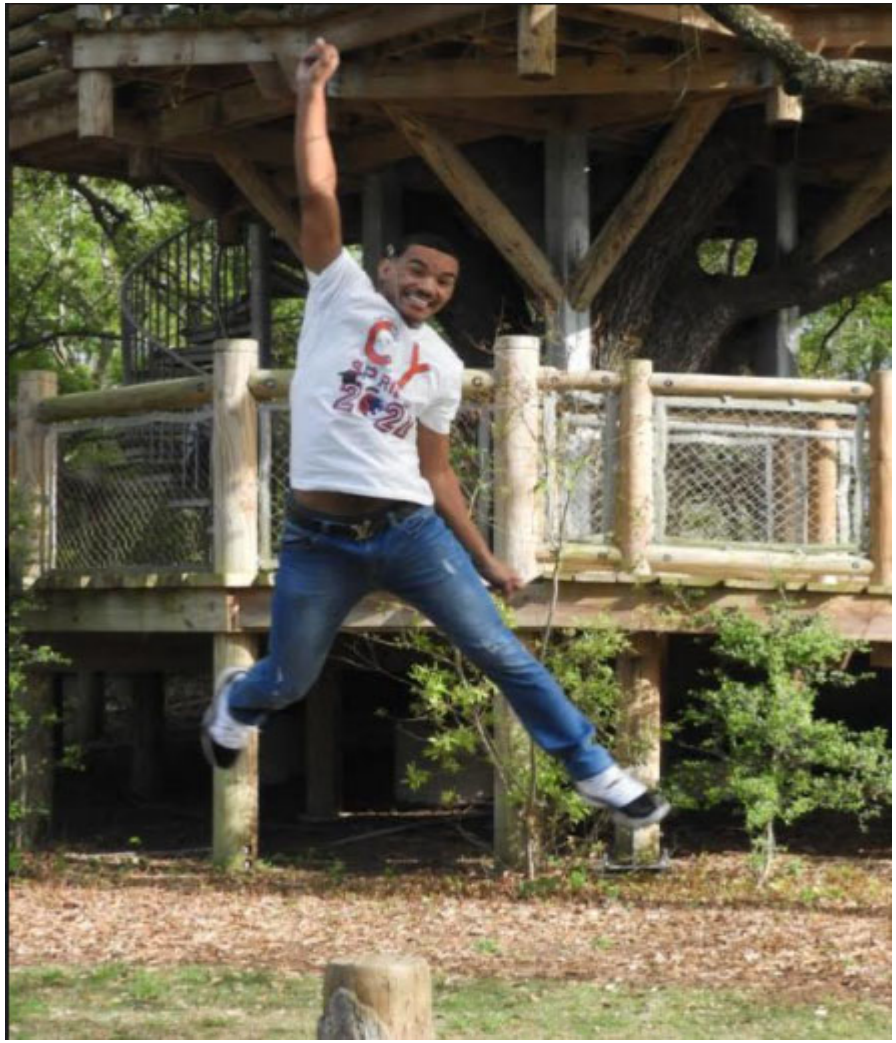
CHALLENGES

The idea

Info

Bryson.gomez15@gmail.com

832-2590-3946



Cypress Springs High School

Industrial Technology

Engineering Design II

Cypress Fairbanks ISD

Cypress, Texas

NASA HUNCH PROGRAM

Team Name

Team members:

1. Reynol Vazquez III

ReynolV03@gmail.com

Instructor:

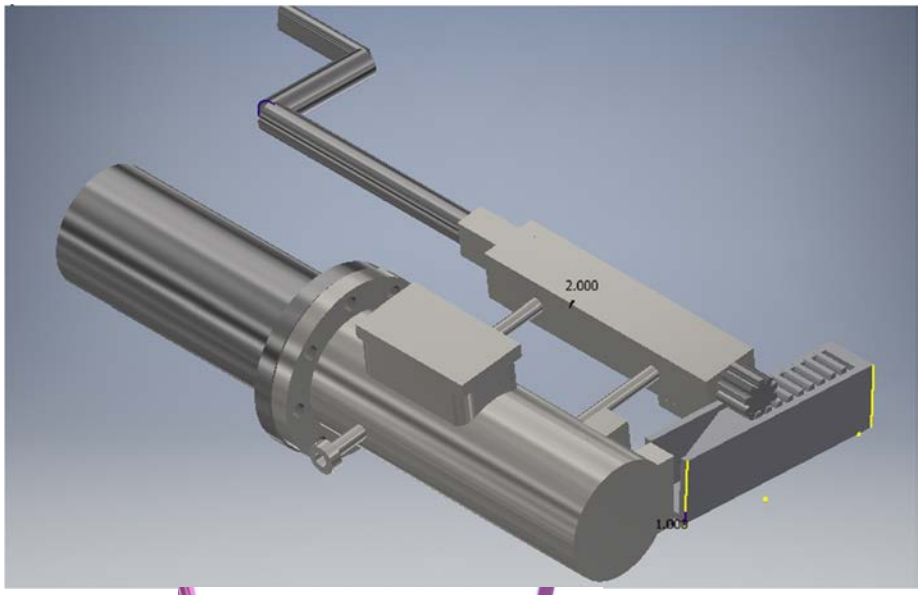
Steven Marcus

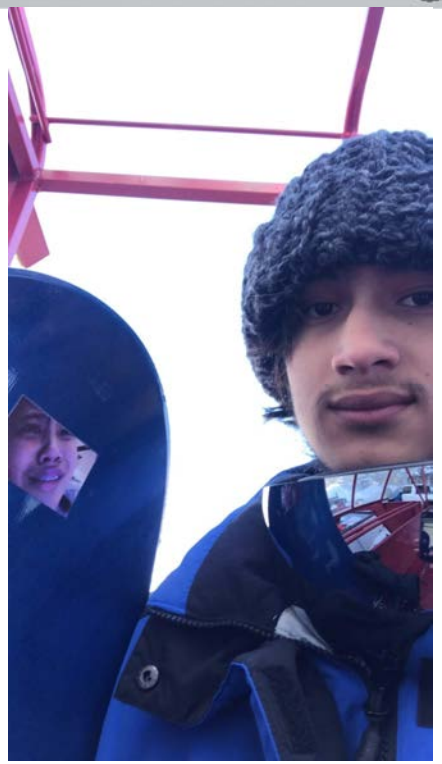
HUNCH Advisor/Mentor

Glen Johnson

Engineering Design II

MARS EJECTOR





GENERAL INFORMATION:

My machine is a tube that has a rod in the back where it'll push out the trash. Once its needed to close the crank will seal the hatch

OBJECTIVES:

Make sure trash leaves my invention, without killing my astronauts.

MATERIALS

My invention consists of it being made out of titanium , which is one of the strongest metals and the ISS is already made of it.

ISSUES

Making sure its thick enough so it doesn't collapse on its self. Also to see that all my components are lined up and is going to be able to do its job.

Cypress Springs High School

Industrial Technology

Engineering Design II

Cypress Fairbanks ISD

Cypress, Texas

GALAXY RAIDERS

NASA HUNCH PROGRAM

INSTRUCTOR:

STEVEN MARCUS

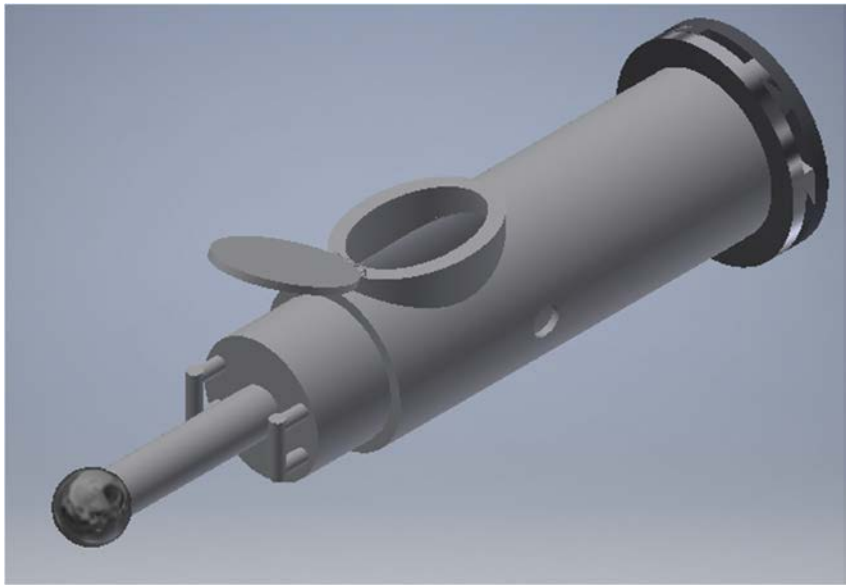
HUNCH ADVISOR/ MENTOR

GLEN JOHNSON

Engineering Design II

Cypress Fairbanks ISD

NASA HUNCH TRASH EJECTOR



The Trash Ejector's main purpose is to eject the trash outside of a spacecraft using a pin for ejection. Our main goal with this device is to create an efficient and safe way to get trash out of a spacecraft.

HIGH SCHOOL STUDENTS, DESIGNERS OF TRASH EJECTOR

Camdyn Brooks

brookscamdyn@yahoo.com

Samuel Vazquez

svaz781@gmail.com

Eduardo Soto

ewadojs@gmail.com

A-TRASH HATCH

The purpose of the trash hatch is to help create an easy way to place trash inside the trash container.

B-LOCKING TEETH

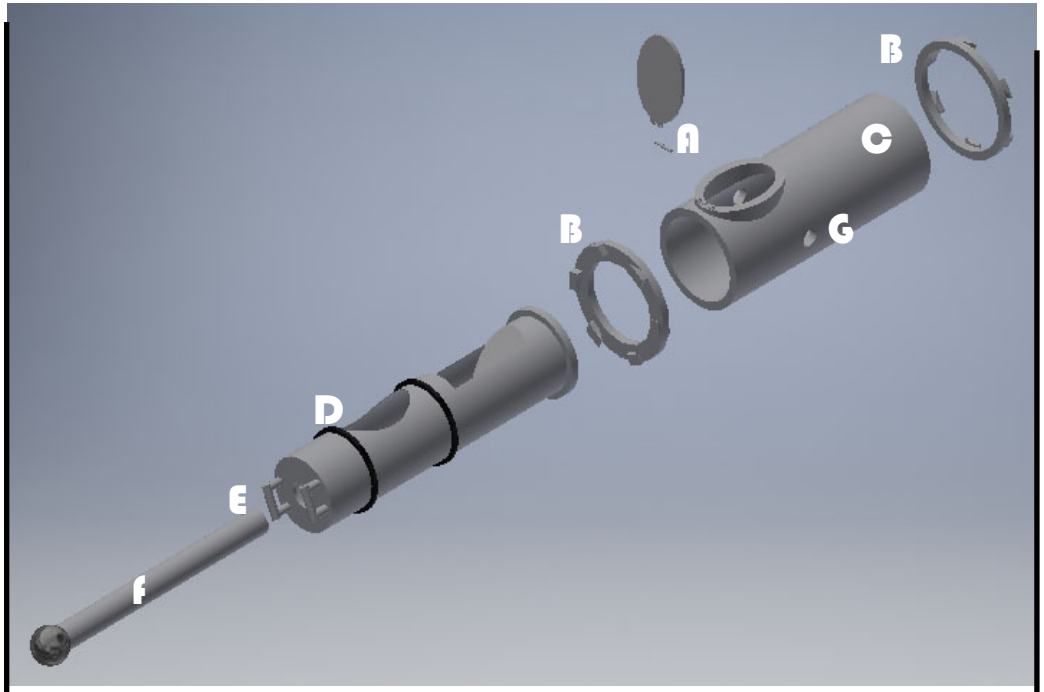
The locking teeth are used to keep the inner pipe from floating away

C-OUTER PIPE

The outer pipe is a stationary cover for the inner pipe to help it move securely and give the device a good hold to function properly

D-INNER PIPE

The inner pipe holds the trash container and has two openings to help the trash enter and exit. This pipe rotates 25 degrees clockwise and back to enforce the locking mechanism. The Inner pipe can also move back and forth to help the trash exit.



E-HANDLE BARS

The handlebars are used to help rotate the device 25 degrees to lock the device. The handlebars are also used to help push the device back and forth for ejection

F-EJECTION MECHANISM

This device is used to push the trash container out of the inner tube and into space.

G-PRESSURE REGULATING HOLES

These holes located on the side of the outer pipe help regulate the pressure and save air when ejecting trash.

Team Brochure

HUNCH TRASH EJECTOR

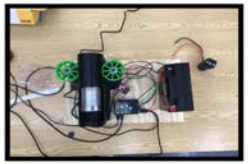
For more details about our prototype, visit our website: Spacesmiths Trash Ejector!

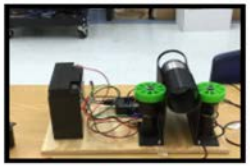
School: Sanger High School

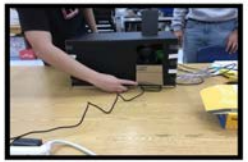
Teacher: Mrs. Garvis

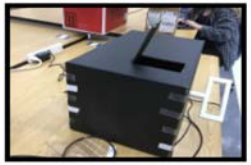
Team members: Joseph Phrachanhsay, Andy Vang, Mia Gallardo, Jesus Vargas

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.

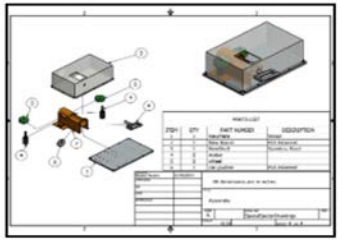




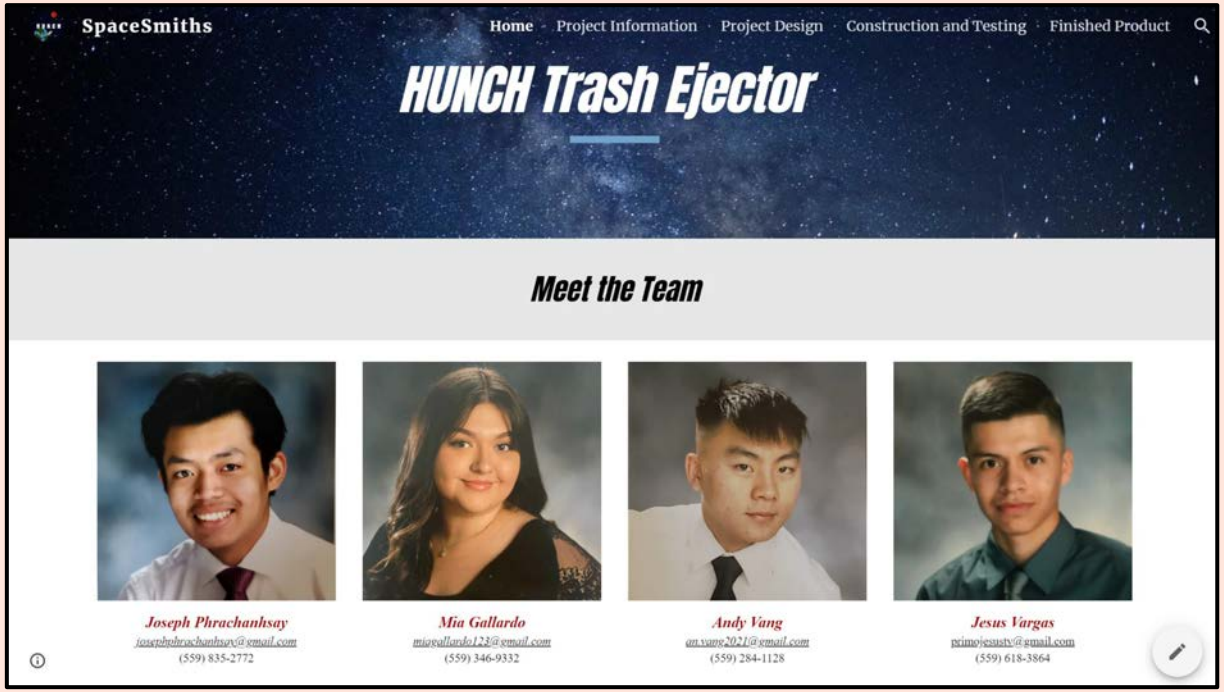




Final CAD Assembly:



Team Website



Materials

Certain parts like the outer doors, guiding rod & rail bar, outer hinge supports, & connecting bracket all had intricate features specific to our design. Their features couldn't be re-created through conventional materials or tools so we opted for ABS plastic parts that were 3D printed by the F170 Strata System.

Other components, like those seen in the picture, were easy to find online or at hardware stores like Lowe's and Home Depot. For more specific parts- namely the nuts, bolts and springs- we had to order directly through McMaster Carr,

Construction

Construction took place over the course of several weeks. A lot of the parts like the outer shell and launch rod had to be cut to size while others needed to be properly secured together using nuts, bolts, and screws.

We made sure all of our measuring, cutting, and construction was precise to ensure we weren't wasting any materials and the design would work as intended. Still, a lot of adjustment and fine tuning was required.

About Us

THE BRAINS BEHIND THE DESIGN

Lucas White is an 11th grader; he focused on the presentation of the design, perfecting the tri-fold presentation board. He was also responsible for many of the initial prototypes, early drawings & overall coordination of the project. He hopes to graduate from Texas A&M with a major in civil engineering.

Rachel Dusek is an 11th grader at Bridgeland High School. She was in charge of research & development. She drafted many of the final parts for the design in Inventor and also aided in the final digital presentation of the project. She plans to graduate from Purdue with a degree in mechanical engineering.

Reily Garcia is an 11th grader. He took the reins on constructing the final design. He helped gather necessary materials & spent time adjusting key components. He also helped develop many of the 3D elements of the design. He hopes to graduate from A&M with a major in civil engineering.

Contact Us

Reily Garcia: 346:-332-5522
Lucas White; 832-418-5312
Rachel Dusek: 281-692-4545

Bridgeland High School:
10707 Mason Rd.Cypress, Texas 77433
Phone: 832-349-7600

Trash Cannon

LUCAS WHITE
REILY GARCIA
RACHEL DUSEK

Prototype

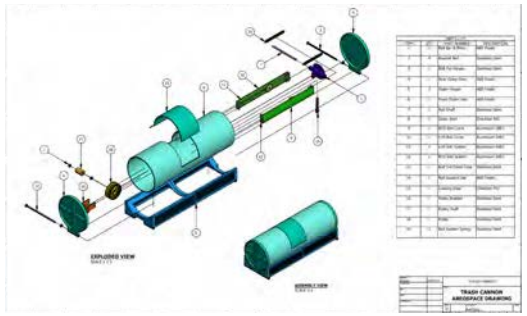
Our first prototype was meant to give us a physical representation of our initial concepts. The materials we chose- plastic, cardboard, duct tape, and balsa wood- were all cheap and easy to manipulate. We did our best to keep everything to scale (1:3) and true to our computerized design. While the design was not functional, it allowed us to understand how the components of our design worked together; we began to understand the limitations of our initial idea, what needed to be improved, and what our next steps needed to be.

Cardboard Prototype

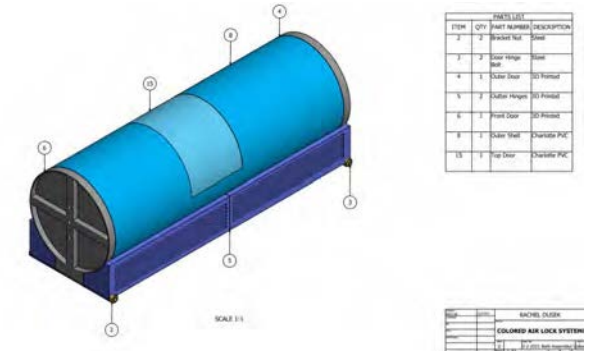
Rail system Mock-Up

[Follow This Link To Learn More About The Changes We Made & How We Would Modify Our Design For Space]

Our Design



Our design is comprised of two main pieces: the airlock system and the rail system. The airlock system is comprised of an outer shell that is mounted on a supportive base. Attached to the base are two doors, on either side, that latch on to the tube, creating an airtight seal. The rail system consists of a loading and launching mechanism that is guided by two rails that run along the tube. The rails will be attached to springs that will hold tension, giving the trash the necessary force to be launched from the spacecraft when the elastic potential energy is converted to kinetic energy.

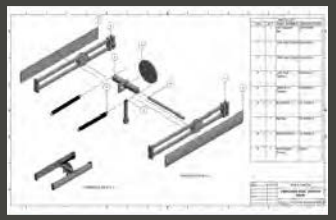


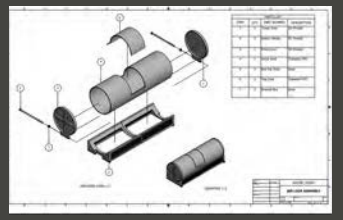
Digital Presentation

Breakdown

AIRLOCK SYSTEM

The airlock system is made of a central housing tube, two outer doors, an upper loading door, and a hinged compartment attached underneath the central housing tube. The design might not be airtight just yet (pun intended), but we already have the plans drawn out for space-automatic doors and pressurized seals will replace manual latches and basic hinges.





RAIL SYSTEM

The rail system of our design is contained in the center of the main tube, with the rails screwed in and aligned horizontally along opposite sides of the inner diameter of the tube. Attached in front of the rail bar is a permanent launch plate where we will mount the launch cup in order to secure the trash in place while it's in motion. We have made the design so that the launch cups can be interchanged depending on the size and mass of the trash to be ejected. Looped through the central metal rod and two extrusions at the front of the rail system will be two extension springs that provide the force needed to launch the can. The tension held in these springs will be controlled by adjusting the length of the cable being fed through a pulley operated by an electric motor. The pulley is mounted in the center of the rear outer door of the chamber. The cable will be secured to the rail bar through a carabiner clip that is attached to a connecting bracket on the back of the rail bar.