Mars Vehicle Trash Ejector
Honorable Mention

for

NASA HUNCH

Design and Prototyping 2021

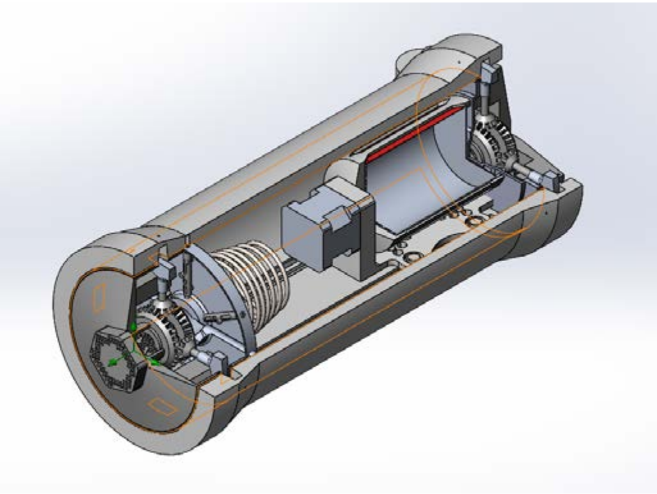
Congratulations for being chosen to receive an Honorable Mention for NASA HUNCH Design and Prototype 2021. This is to provide more praise for those who have done significant design and testing. Take pride in knowing that your work demonstrated many significant innovations and ideas. HUNCH recognizes that your team put a lot of thought and time into your design and testing. You had multiple prototypes you worked through, completed several interesting ideas, did testing with each prototype, demonstrated a deeper knowledge and skill in CAD.

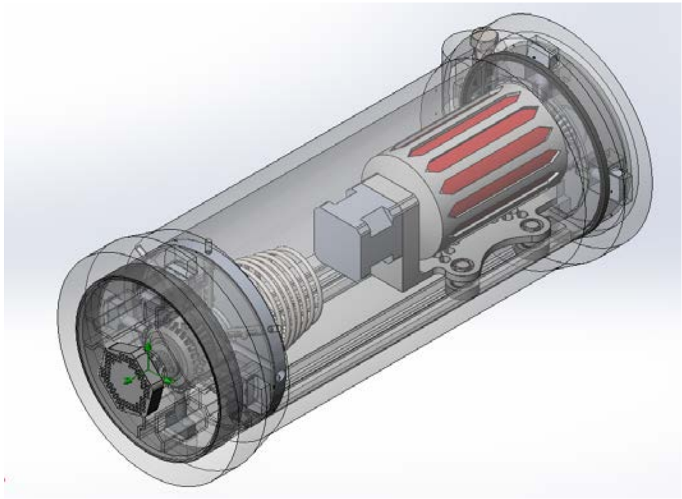
Although you are not being invited to the Final Design Review, your work will remain on the HUNCH design and prototype page where it will continue to show the hard work your team put into the project.

MARS TRASH EJECTOR

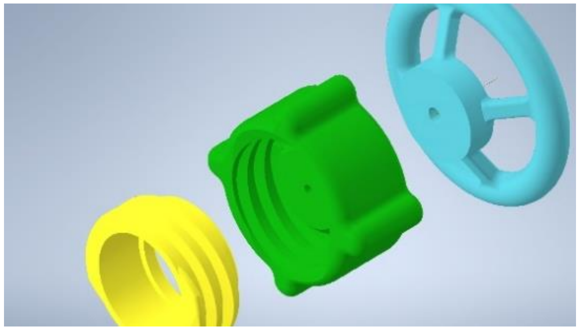
ZACHARY FITZJARRELL - CHEROKEE TRAIL HIGH SCHOOL (TEACHER - BENJAMIN NUEBEL)

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.

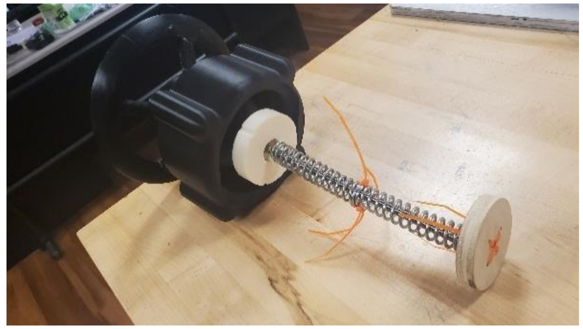




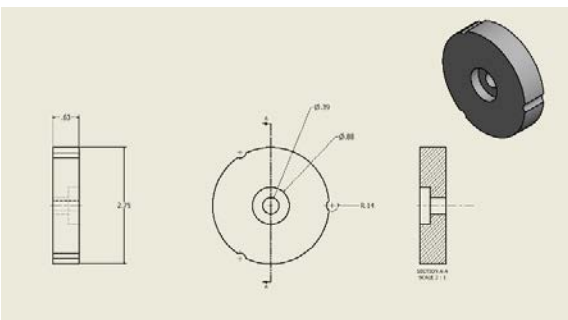
PICTURES



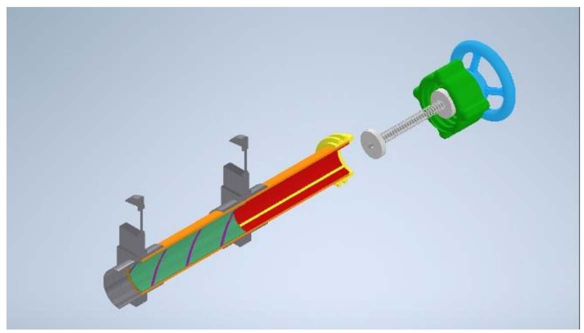
CAP THREADS AND HANDLE ASSEMBLY



FULLY CONSTRUCTED CAP AND PLPUNGER

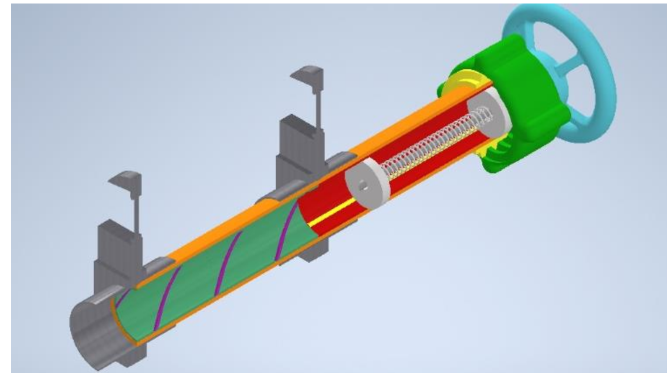


DIMENSIONED PLATE



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

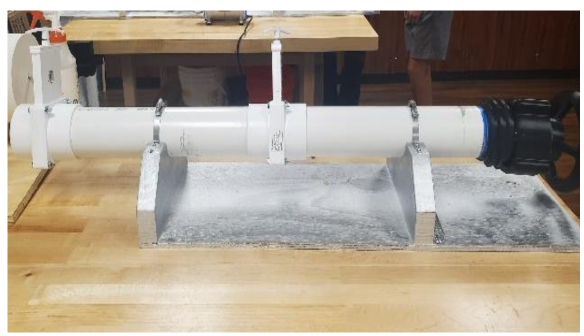
High school students United with NASA to Create Hardware

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

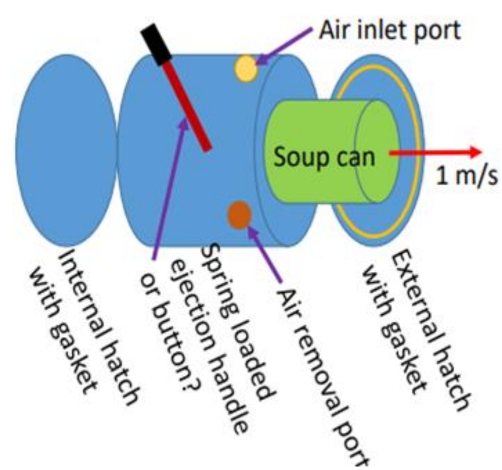
SIDE VIEW OF FINAL DESIGN

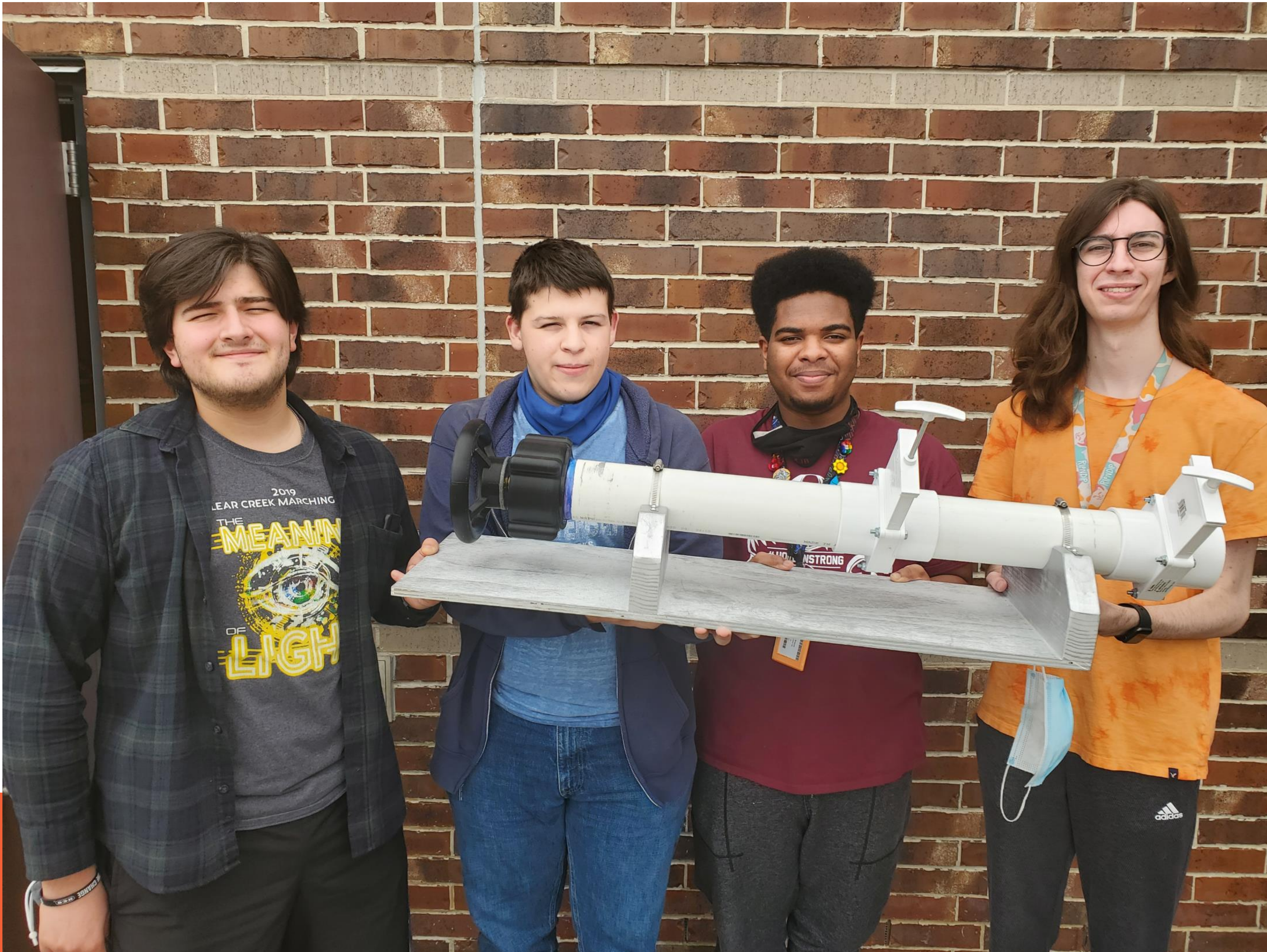


OBJECTIVE

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
MEANIN
OF
LIGH
adidas

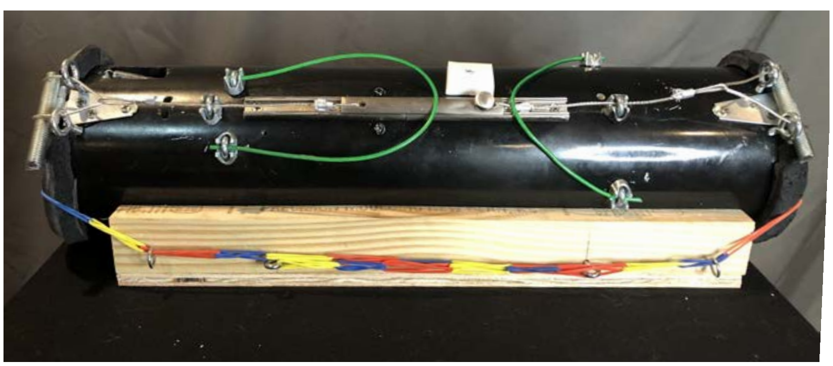
Jeremy Felker & Spencer Kauffman
Chatfield Senior High School
Contact: Joel Bertelsen
Email: jbertels@jeffco.k12.co.us

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.

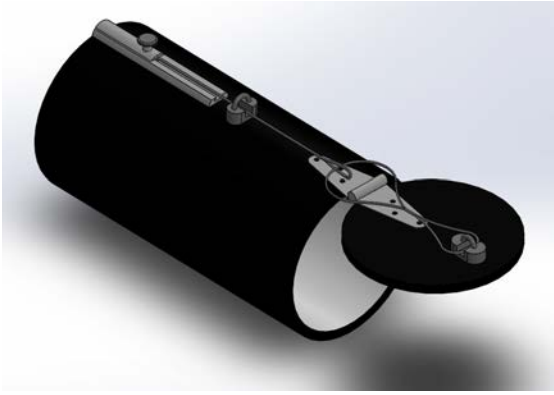
Loading System - Using two CAD-designed 3D printed parts, allows for the insertion and removal of the trash from the interior of the spacecraft while still allowing for an effective launch of the trash.

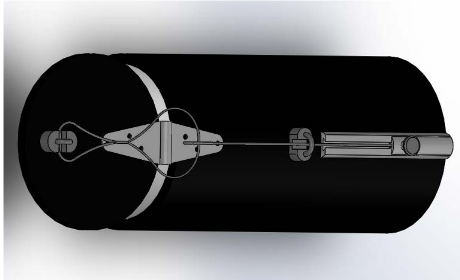
Launch System - Comprising extension springs, a PVC launch stopper, and a custom designed launch pin, controls the launch of the trash ejector and the trajectory that follows.

Highlights

Hatch System

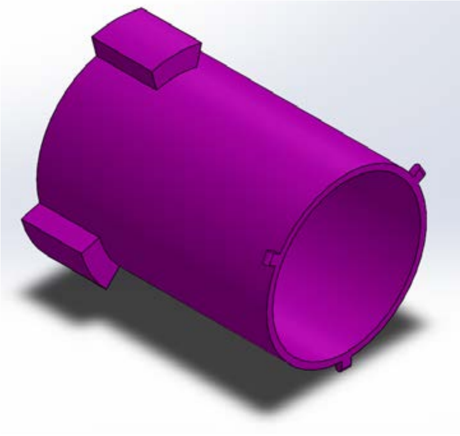
- Comprises a sliding latch, 1/16 in wire clamps, 1/16 in diameter pvc covered wires, small gate hinges, 4.5 in diameter wood hatches, and rubber bands (not pictured)
- Sliding latch and wire allow for opening and closing of one hatch at a time
    - When the wire is moved forward, it bends and doesn't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

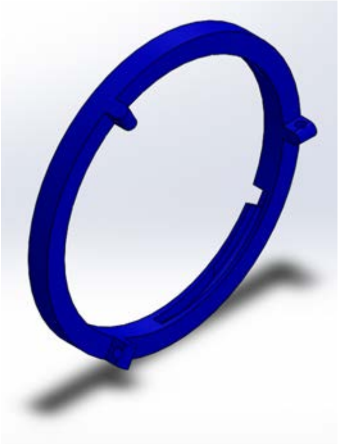




Loading System

- 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

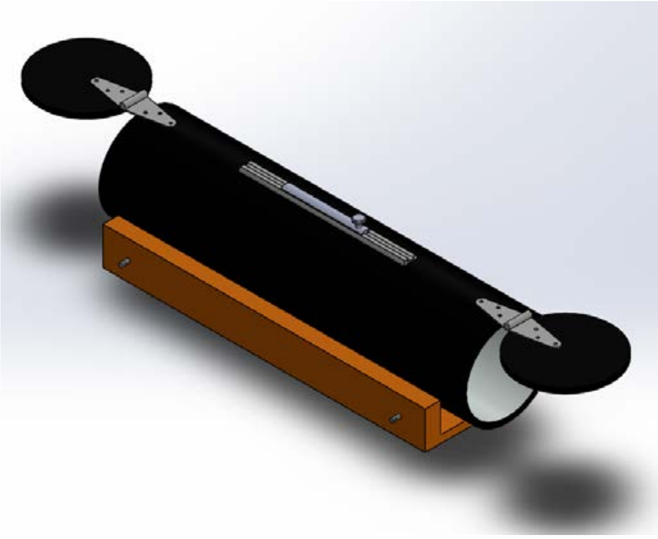
Load Test

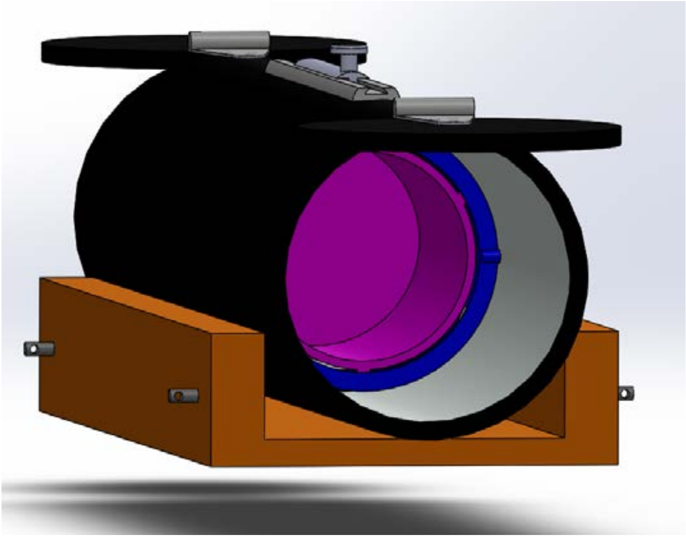
- Another crucial component to our trash ejector was the loading and unloading of the launch canister into the trash ejector and launch connector
- This test was completed by timing the insertion of the launch canister 10 times and then finding the average based on that
- Average time came out to be 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

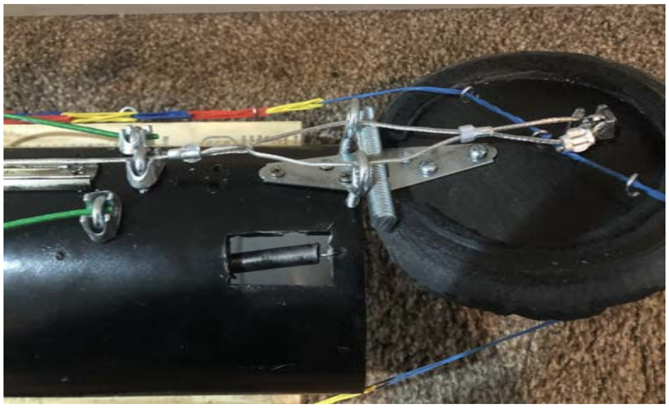




Additional Close Up Photos

Interior without launch canister

Interior with launch canister



External hatch system

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

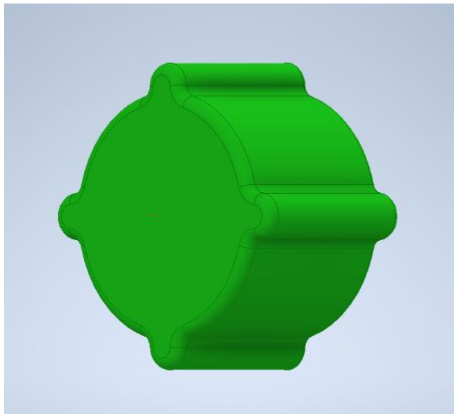
The Project

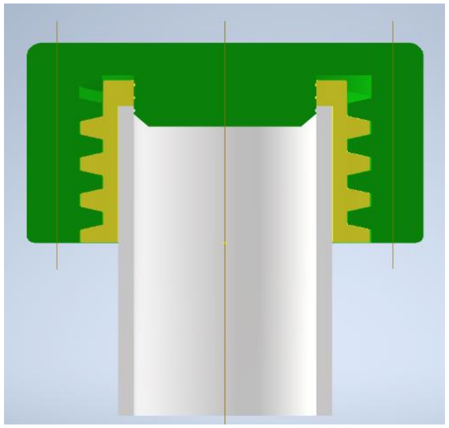
Purpose

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

Mars Trash Ejector

School:

Cherokee Trail High School

Teacher:

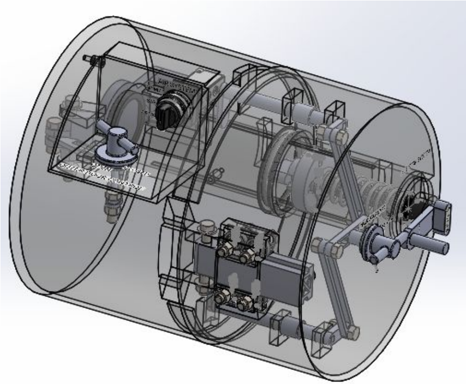
Ben Nuebel

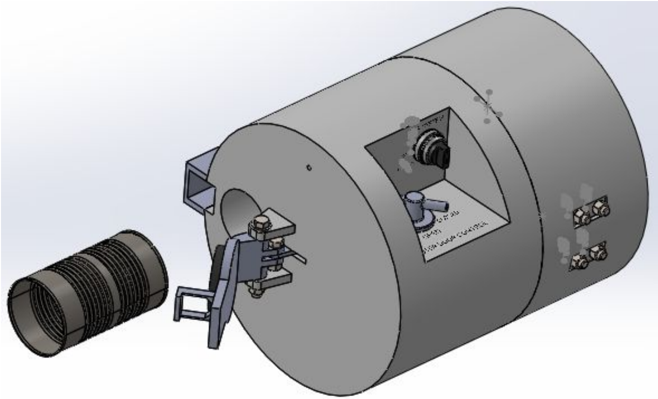
Students:

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.





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.

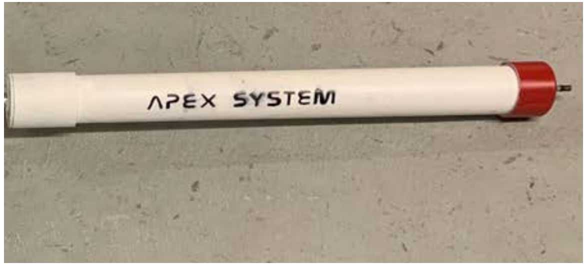
Pressure Gauge, Solenoid Valve, and Switch

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.

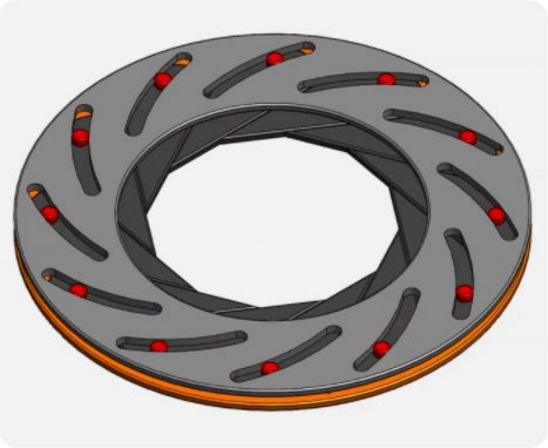
A pneumatic device is the most effective method of doing this because:

- 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

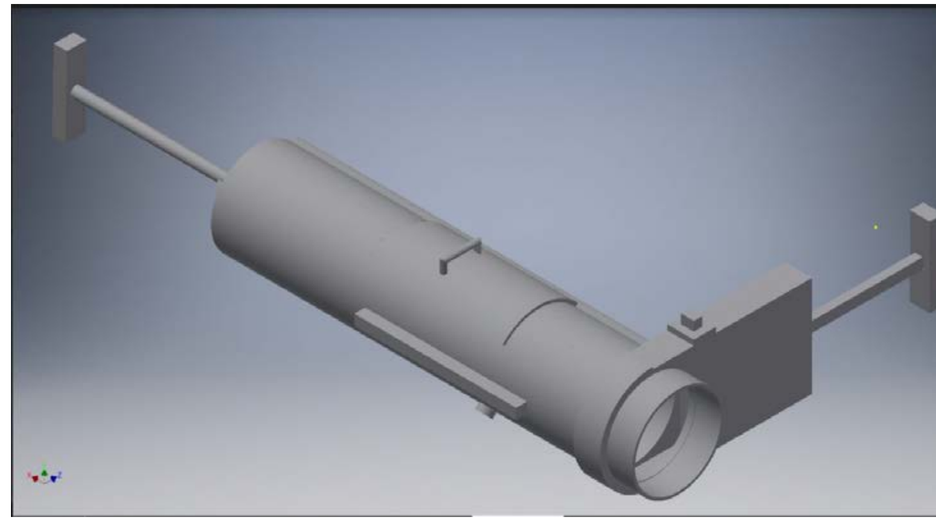
Jacob Brown
Ariana Elze
Mino Elze
Cooper Kern

Chatfield Senior High School
HUNCH Program

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

Trash Ejector 2020-2021

BILLINGS CAREER CENTER



School - **Billings Career Center**

Teacher - **Eric Anderson**

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

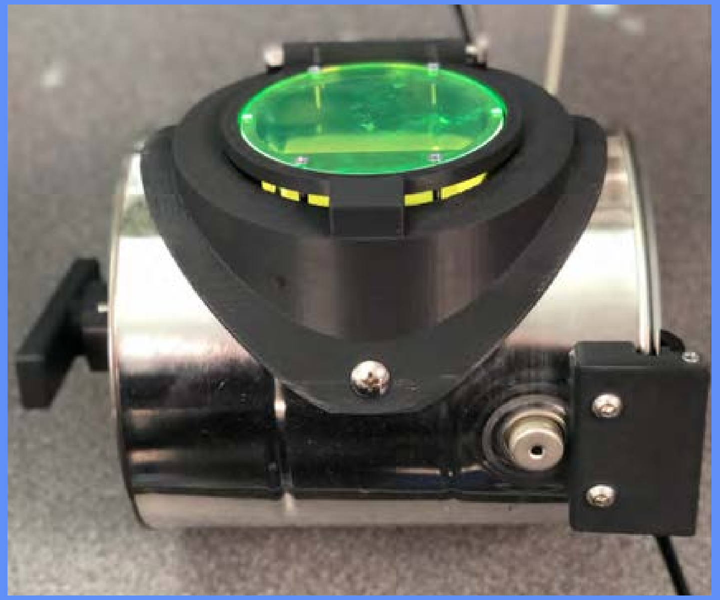
Description - **This trash ejector is perfect for the Mars mission because it is efficient, accurate, and is able to remove the garbage with the bear minimum simplicity. As well as equipped with an airtight mechanism to safely launch the trash.**

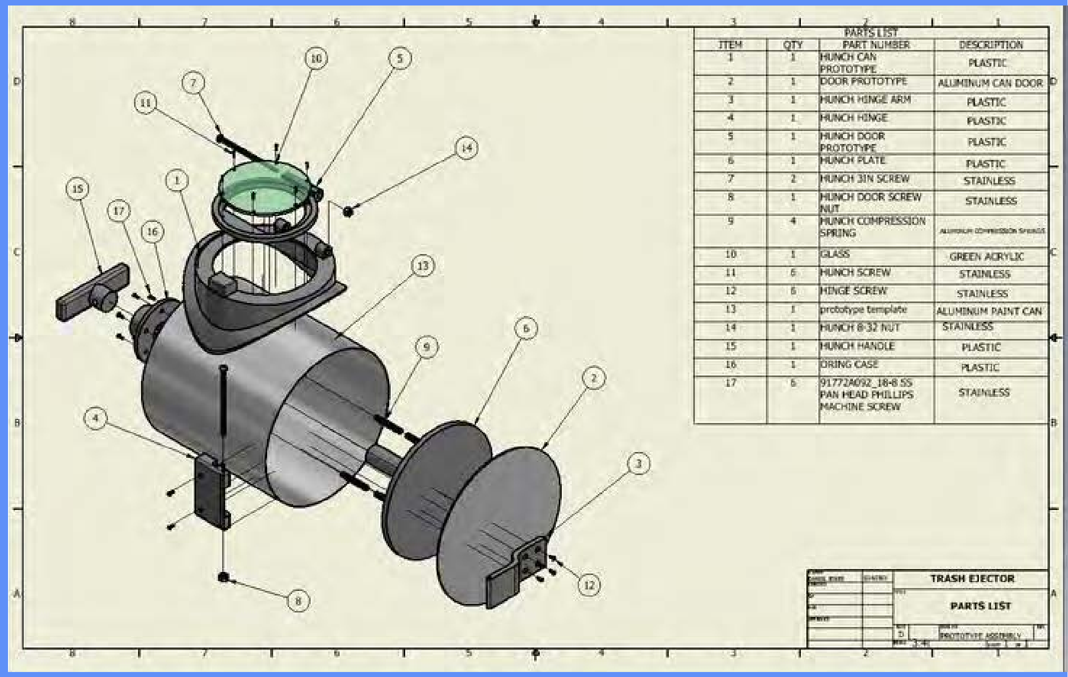
BRIDGELAND
HIGH SCHOOL

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

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.

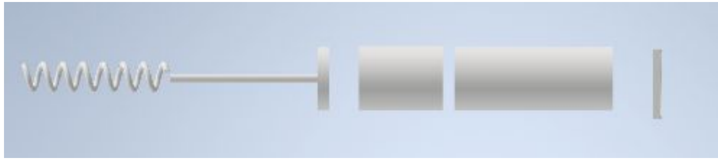
Design and Engineering Concepts

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.

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.

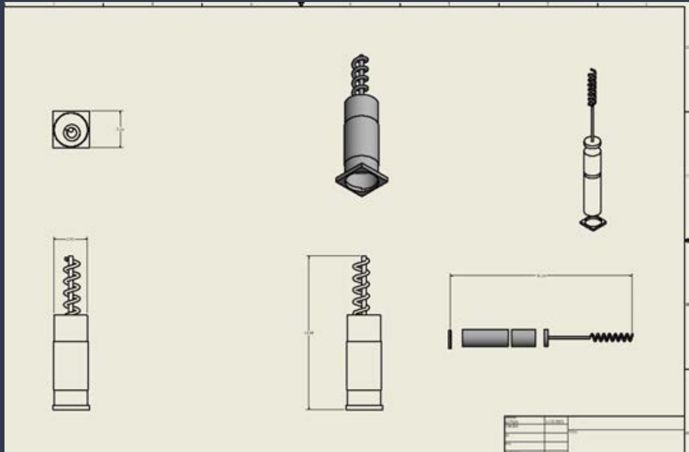
Specifics of Design (design specification)

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.



Cypress Springs High School

Industrial Technology

Engineering Design II

Cypress Fairbanks ISD

Cypress, Texas

NASA HUNCH PROGRAM

Name

Bryson Gomez

Instructor:

Steven Marcus

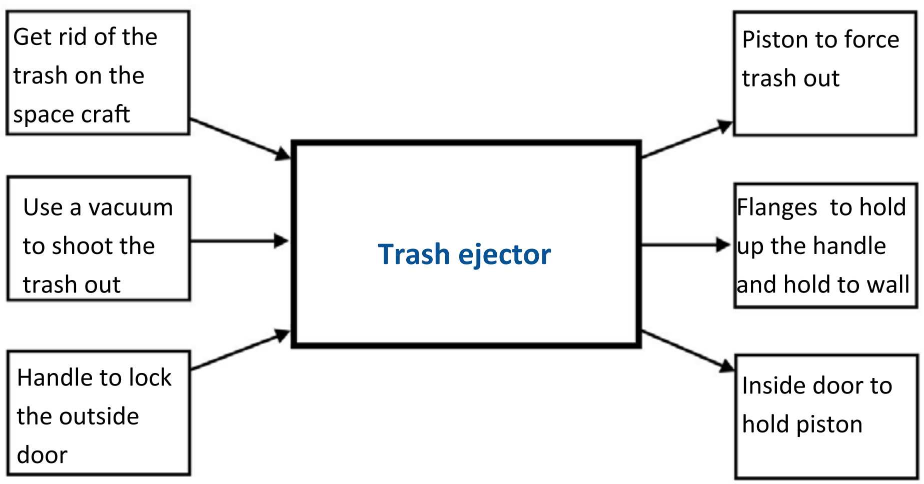
HUNCH Advisor/Mentor

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

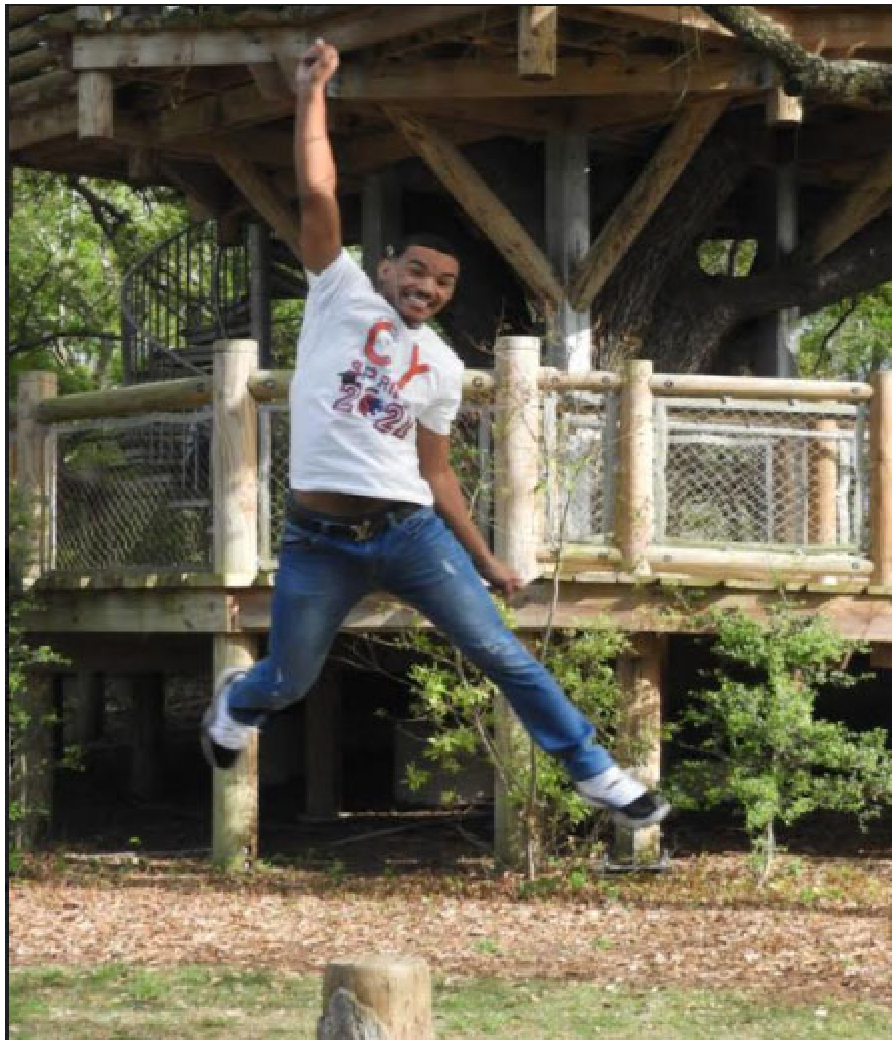
CHALLENGES

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:

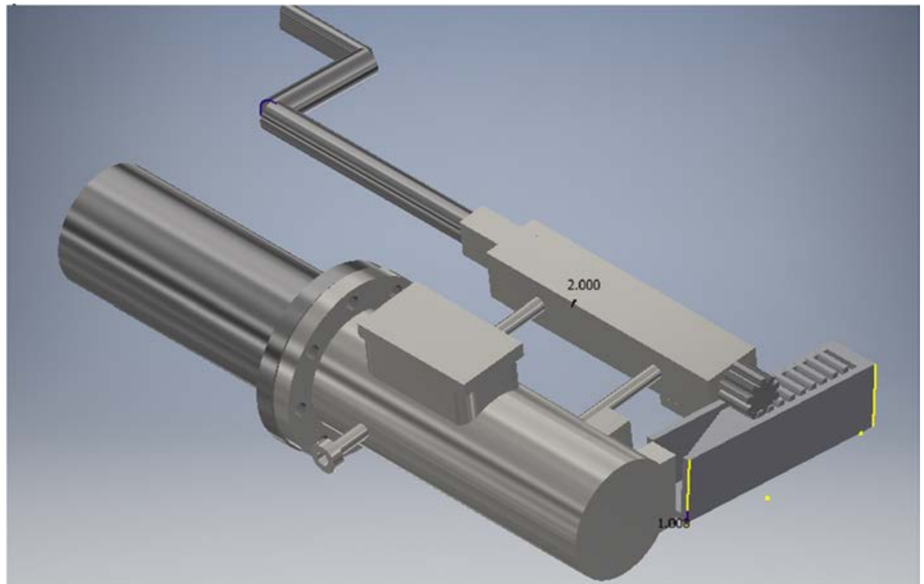
Steven Marcus

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

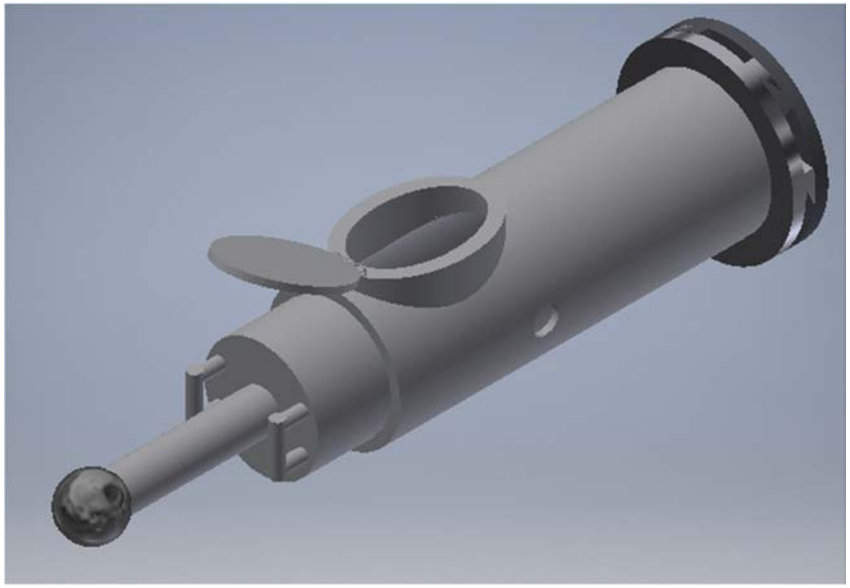
HUNCH ADVISOR/ MENTOR

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

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Samuel Vazquez

svaz781@gmail.com

Eduardo Soto

ewadojs@gmail.com

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

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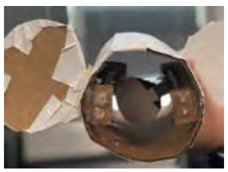
Trash Cannon

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.

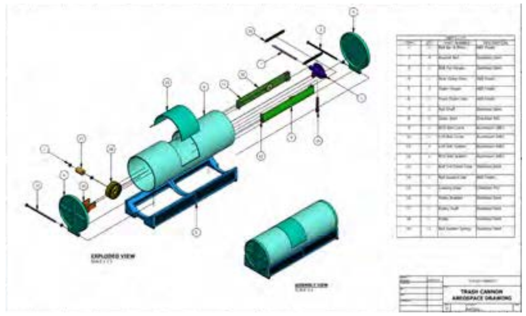


Cardboard Prototype

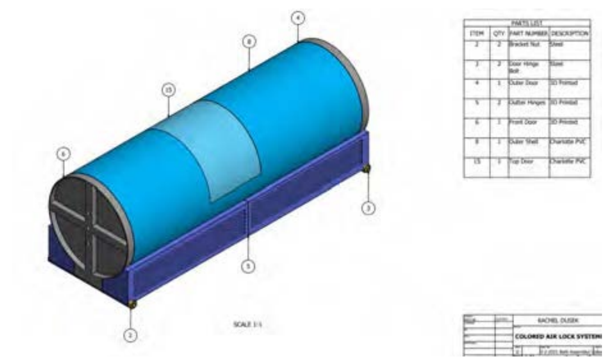
Rail system Mock-Up

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.

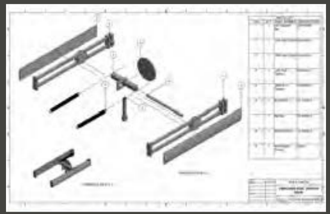


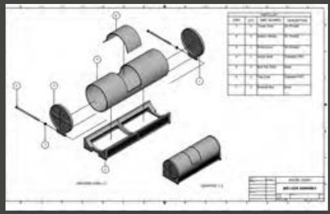
Digital Presentation

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.