2022 Design and Prototype Finalists

Lunar Habitat Shoes

Students: Carson Koch, Elliott Piatt, Samuel Roberts, Drew Huff
Teacher: Julie Morgan
School: Cole Valley Christian, Idaho

Students: Lynelle Yadao-Ellazar, Anja Marie Henriques, Mikaella Casino
Teacher: Frederick Hermann
School: Makua Lani Christian Academy, Hawaii
Students: Blake Iverson, Evan Herzog Barb Mcgregor
Teacher: Eric Anderson
School: Billings Career Center, Montana

Students: Akhil Asher, Eleana Yerre
Teacher: Michael Hayes
School: Bridge Builder Academy, Texas

Students: Olivia Graves, Elliot Berger
Teacher: Nate Olsen
School: Warren Tech Central, Colorado

Students: Jaynah Hasler, Joan Ake, Danial Olivas
Teacher: Nate Olsen
School: Warren Tech, Colorado

Students: Elijah Sanchez
Teacher: Pederson
School: Lakewood, Colorado

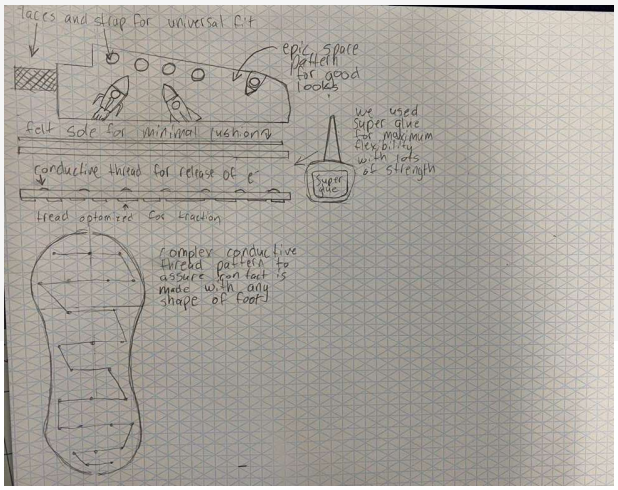
Lunaire

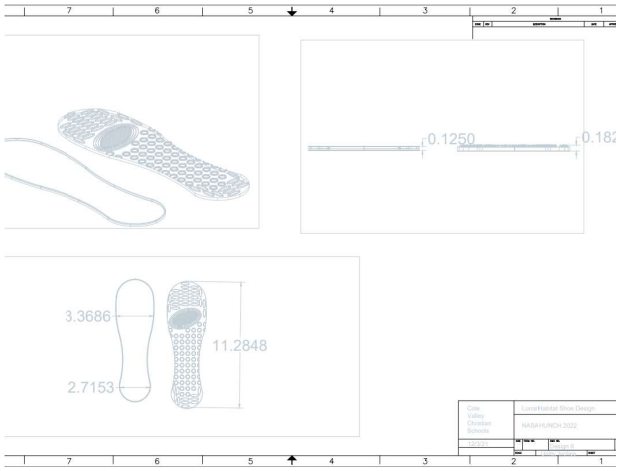
Shoe Specs

- We chose to create our sole out of TPU filament because of its flexibility.
- In the upper part of the shoe, we used materials such as felt and fabric to add structure and cover for the shoe.

Shoe Design

- We designed our sole with the help of AutoCAD and later scaled the shoe using CuraLulzbot, before printing it





Lunaire

Data

- T = Fp = 29.5N
- 15lb x 4.448N / 1lb = 66.72
- M = 29.5 / 66.72 = 0.442

Electrostatic Discharge

- Our flooring is an ESD mat
- Inside the shoe and the sole is conductive thread to effectively discharge and help you drain electricity
- We hope to eliminate the risk of static build up by using this system.

The Lunar Habitat Shoe

lunare
sole heelers

Our Team:

[pictured left to right:]
Lynelle Yadao-Ellazar, Anja Marie Henriques, Mikaella Casino

The Final Prototype

The Shoe:

- Custom fitted
- Upper Nomex
- Infrared tested cooling vents
- EVA foam padding for structure
- Lunar trolley tested outsole
- Compatible with modified ESD flooring

The Floor:

- ESD flooring
- Dissipates static charges
- Rough side of flooring for traction and grip
- Electrically conductive paint to prevent fraying
- Paint modified with anti-skid additive

The Lunar Trolley:

- Simulates lunar gravity
- Allows evaluation of prototype shoe and floor
- Conclusion: Firm sole for shock and rough floor for traction is preferred.

Test Results:

Anja Walking on Lunar Trolley with Final Prototype Shoe & Flooring

Anja Moonhopping on Lunar Trolley with Final Prototype Shoe & Flooring

Anja Moonhopping (towards Camera) on Lunar Trolley with Final Prototype Shoe & Flooring

NASA HUNCH

Lunar Shoes

Billings Career center

Mr. Anderson
Blake Iverson, Evan Herzog Barb Mcgregor

- We designed a replacement for velcro/ laces that allows the shoe to be fastened seamlessly with low gravity in mind.
- The shoe sole is designed to have great traction while maintaining a simple profile for easy cleaning.
- The sole was designed in CAD and was 3D printed using V2 flexible resin. We recommend that the real deal is made from fluorosilicone and flexible PVC.
- Was created with a special design that would give the most comfort and traction, while being static dissipative, fireproof, and simple overall.

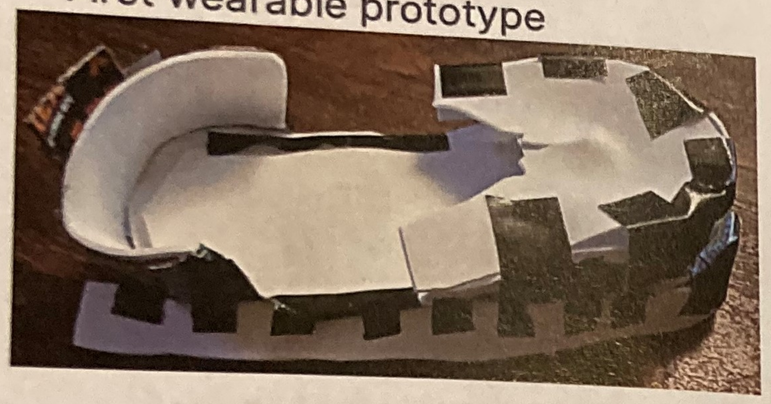
- The covering cloth for the foot is made out of nomex, kevlar, and elastic nomex.
- The straps that allow the shoe to perfectly form fit to the foot are made of an elastic nomex from Sentry FR® Nomex® FR Elastic.
- The shoe is designed to easily compact for storage.
- All materials to be used are lightweight
- Floor panels designed to have good friction, low static, fireproof, long lifespan, and easy to transport.

https://www.youtube.com/watch?v=79oztPuNBw8

The Billings Career Center


LUNAR SHOES
SPACE WALKERS
Akhil & Elena
MR. HAYES
3D Model
Layers of the Shoes
Research Facts
Diagram
Brainstorming
Key Design Features & Test Video
Brainstorming Continued
Test Plan and Results
Published Website
Space Walkers
FICTION
BRIDGE BUILDER
VISITOR
Columbia
PROTOTYPE
PROTOTYPE

First wearable prototype



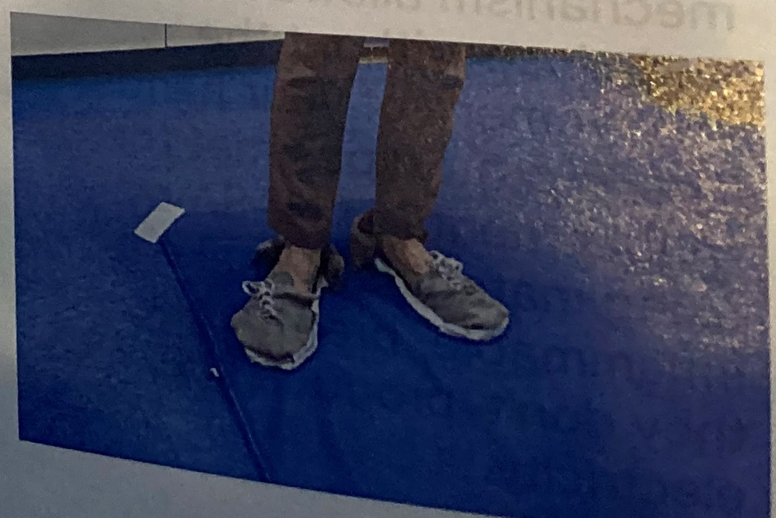
Over time, we have made four prototypes, including the latest. The first two were made for more of a test to see what ways were better to build it. The third was our presentation that accurately, but not fully, represented what out design would be like. The last two were fully functioning prototypes. Wen working on the prototypes, we found that some ways to build shoes are more efficient and reliable than others.

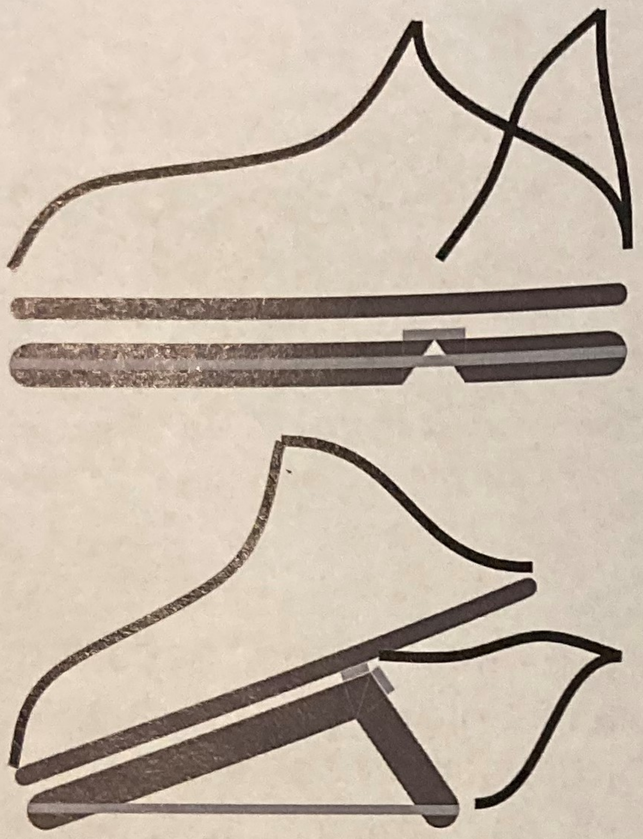
Third mechanical prototype

While making the third prototype, we constructed the design to represent the way our shoes would work. The mechanism would be incorporated into the inner sole of the shoe. It would have cushioning surrounding it and would be thinner. The mechanism is controlled by elastics in between the base, and inner sole of the shoe. It holds it up when not in use, and will help it remain on your foot.

Second Wearable prototype

After making the shoes, we and a group of individuals from our school tried on the shoes to make sure it held all the attributes. The testers tried on the shoes and gave feedback on what was good about the shoes, and what could be improved. These questions included if they were comfortable, if they looked okay, and other characteristics of the shoe.





In working on the prototype, we discovered a multitude of materials and adhesives would be needed to make the final product. While making the shoes, we also designed and inserted a mechanism to operate the shoe. The mechanism allows it to open and close without the involvement of your hands. These prototypes met the requirements of NASA by using materials to make it inflammable, breathable, and they don't produce static electricity.

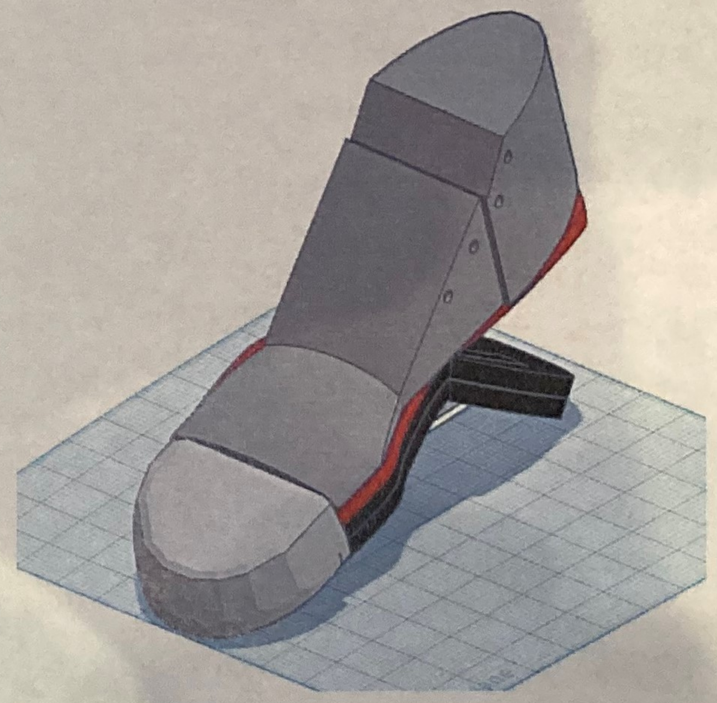
We have put together a website that shows what we have been working on, the progress that we've made, and the benefits of making mistakes for the end result.

Our website address is: https://bba-nasa-hunch-space-walkers.netlify.app/

You can use it to observe our progress on our project, contact us, and ask questions. Our website also shows pictures of our progress throughout the time we've worked.

Space Walkers

By: Akhil Asher, and Eleana Yerre
From: Bridge Builder Academy
Directed by: Mr. Michael Hayes



Our shoes will meet all of NASA's requirements to be worn in the Lunar Habitat with ⅙ the gravity of Earth.

Lunar Shoes
Warren Tech
Mr. Olsen
Olivia, Elliot, Audra,
Anna

Why our Nano-Lab?

Our Nano-Lab has incredible promise to grow fungus in Zero-G to eventually be able to grow any plants in space. The Fungus Nano-Lab is a 10x10x20 lab that can affordably grow and

Fungus Nano L

Warren Tech Centra
STEM program
Mr. Olsen

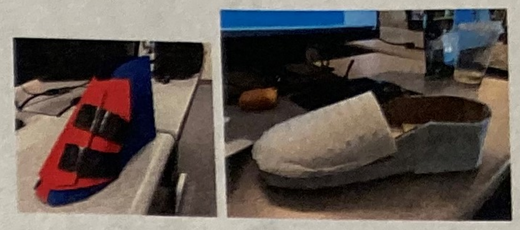
Starting on the left: Baila Burnam, Tristan Burnham, Josh Kempe, Sophia Sills

SDC-30 Temperature, Humidity, CO2 Sensor
Raspberry Pi 0
FOV Camera
chamber
water distribution mechanism

Our shoe will have a 3D printed sole made of silicone (can be replaced with other materials) with a honeycomb pattern by the toes and heel for traction. On the inside for comfort and arch support we will have a purple mattress cut to size. The material will be from a company called Milliken who will be supplying us with a stretchy, fire resistant, and anti-friction material. Also, a shock proof material as well which we can test on.

Lunar Shoes
Warren Tech
Mr. Olsen
Olivia Graves + Elliot Berger

Olivia + Elliot



(Prototypes)

A couple reasons as to why ours would stand out is the comfort of the shoe on the inside and the elastic to make sure it bends with your foot when you walk. It will also have velcro on the top to make it easier to put on. The material we are using will be fire resistant and also lightweight so it isn't heavy on your foot. Also, we are working with another group so we will have the choice between a high top and a low top shoe. We are doing our best to make sure that our product is effective and comfortable, giving the astronauts a way to move around safely in space. Our shoes will be easy to wear and easy to walk in.

Lunar shoe

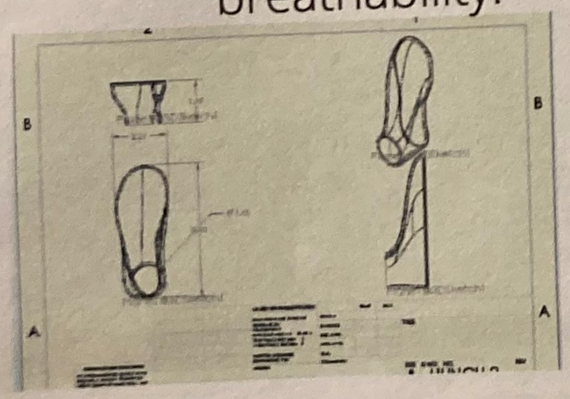
Warren Tech High School

Nathan Olsen

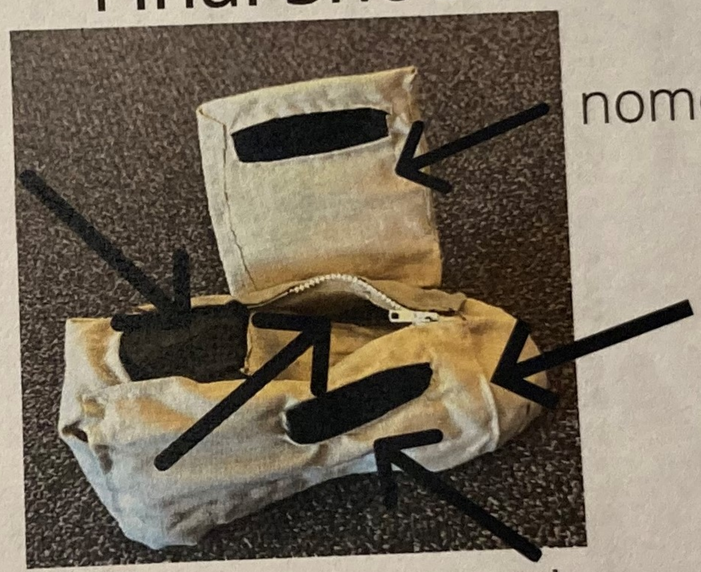
Jaynah Hasler, Joah Ake, Danial Olivas

The highlights of our shoe:

Our shoe is a lightweight, breathable, comfortable, and has compact design that will leave users astounded with all of its features. Some features include our flexible resin sole, Nomex, and our comfortable breathable foam. We also have improved the regular design of an average shoe to make it able to have both an arch support insert and the possibility of a vent to give it additional breathability.



Final Shoe:



Final Floor:

Materials:

Upholstery foam, 6 in. zipper, Nomex, 2 sided velcro, Flexible A80 resin, Black resin V4, polyester shoe top, and arch support shoe sole insert.


LUNAR HABITAT SHOES
Team Member:
Elijah Sanchez
Lakewood Highschool
Teacher:
Ashley Pederson
The Design Statement:
Testing & Analysis:
Final Solution:
Criteria & Constraints:
Materials:

MATERIALS:

Dritz Braided Elastic:

$4 (41 cents per yard) Doesn't produce static out charge / Durable / Withstand High Temperatures / 55 % polyester and 45 % rubber

Silicone Rubber:

$9 ($2.80 per pound) Electrical Insulator / Very Flexible / Withstand High Temperatures / Durable / Keeps Shape

Silicone Insole:

$25 (About $25 for a pair of insoles) Anti-static / Cushion / Non-flammable / Non-stick Ability / Flexible / Durable / Electrical Insulation

Shoe Goo:

$51 ($25.28 per 3.7 fl oz) Withstands -40 to 82 degrees Celsius / Is Non-flammable / Has Strong Hold / Used On Rubber Soles

Gral AST Anti-Static Thread:

$10 (Estimated cost for a 300 yard spool) High Tenacity / Non-flammable / Anti Static

Vinyl Flooring Sheets:

$2 (Per square foot) Anti-static / Fire Retardant / Easy To Clean / Light

PROTOTYPE:

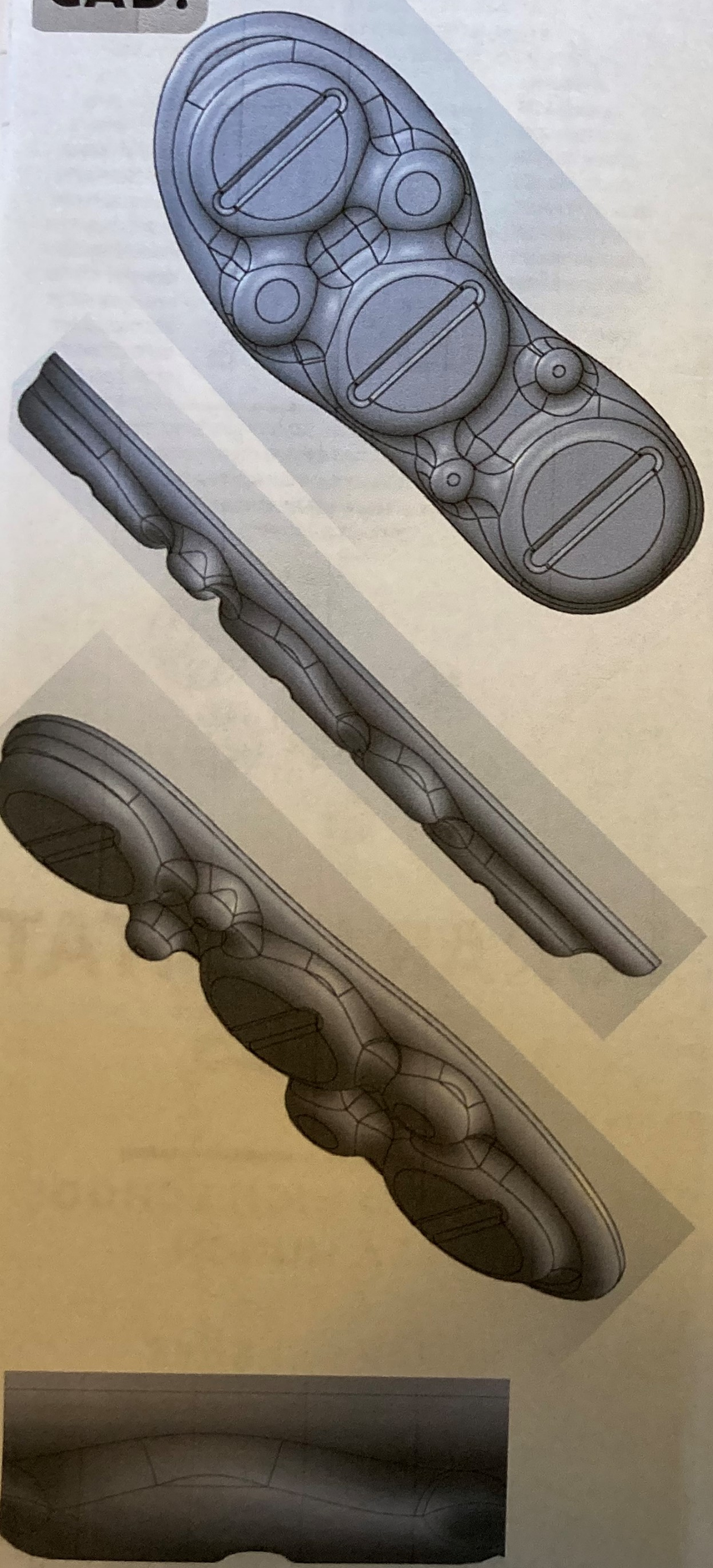
CONTACT

LUNAR HABITAT SHOES

LAKEWOOD HIGH SCHOOL
NASA HUNCH

ELIJAH SANCHEZ

CAD:



FINAL SOLUTION:

The shoe will have a silicon rubber outsole that will have seven rounded extrusions on the bottom. Three having a (3" Diameter) / Two having a (1.5" Diameter) / Two having a (0.75" Diameter). The three largest extrusions will have a cavity of space (2.7" Length / 0.27" Width / 0.07" Depth). The insole will be a silicone insole. Small toe cap made of silicone rubber as well.

The shoe will also have five (Quantity adjusted to size during manufacturing) braided elastic straps that stretch over the top of the foot. There will also be a braided elastic strap traveling down the middle of all the other five straps to connect them. There will be a sixth strap on the back of the shoe to secure the foot traveling around the heel. There will additionally be a heel loop. The exposed end of the middle strap and heel loop should be pulled to loosen all straps for easy foot insertion. There will not be full coverage of the foot. All of the straps will be connected to each other with anti-static thread and the outsole will be connected to the rest of the shoe and insole with Shoe Goo. This design is accommodating to wearers already wearing socks!

A flooring that works well with this shoe model is vinyl flooring sheets. They are easy to install and remove and are easy to clean. They are also anti-static and when compared to other flooring materials; fire retardant.

TESTING:

OUTSOLE - TESTING:

The prototype was worn to test the stability of the shoe and to pinpoint main areas of the outsole that would need support. This was done by wearing the shoe and performing various tasks. More support was needed under the shoe. This is because a lot of weight is put onto the inner and outer sides of the shoe. To solve this problem 4 differing size extrusions were added to the bottom of the sole.

FOOT INSERTION METHOD - TESTING:

To test the functionality of the shoe's insertion mechanism, the wearer did as the mechanism asked. The wearer pulled on the small flap on the top of the foot and carefully inserted their foot. This test demonstrated the functionality and practicality of the pull and step mechanism. The result was that the intended method of putting the shoe on was comfortable and easy.

COMFORT - TESTING:

To test the comfortability of the shoe wearing experience individuals put the shoe on and walked in it round the classroom/hallways. While walking the individuals stated that the shoe felt as if it were slipping off and that the back of their foot felt unsupported. To fix this issue a horizontal strap of elastic was added to the back of the shoe to support the heel and keep the sole to the foot. This additional strap meant that there would be an additional step when putting on the shoe. This step would be pulling the strap back to maneuver the foot inside. To assist in this step a heel loop was added.

STATIC ELECTRICITY - TESTING:

To test the conductivity of the Dritz braided elastic, a strip of the elastic was rubbed vigorously across carpet and bedding. Then the individual carrying out the test touched various metal objects and fabrics. No sparks or shocks were reported.

The same test was carried out but instead the individual tied two straps of the elastic around their bare feet and walked/slid on the carpet for about 10 minutes. They then attempted to touch metal objects and other fabrics. No sparks or shocks were reported.