Generic Ag Nano Lab
Honorable Mention

for

NASA HUNCH

Design and Prototyping 2021

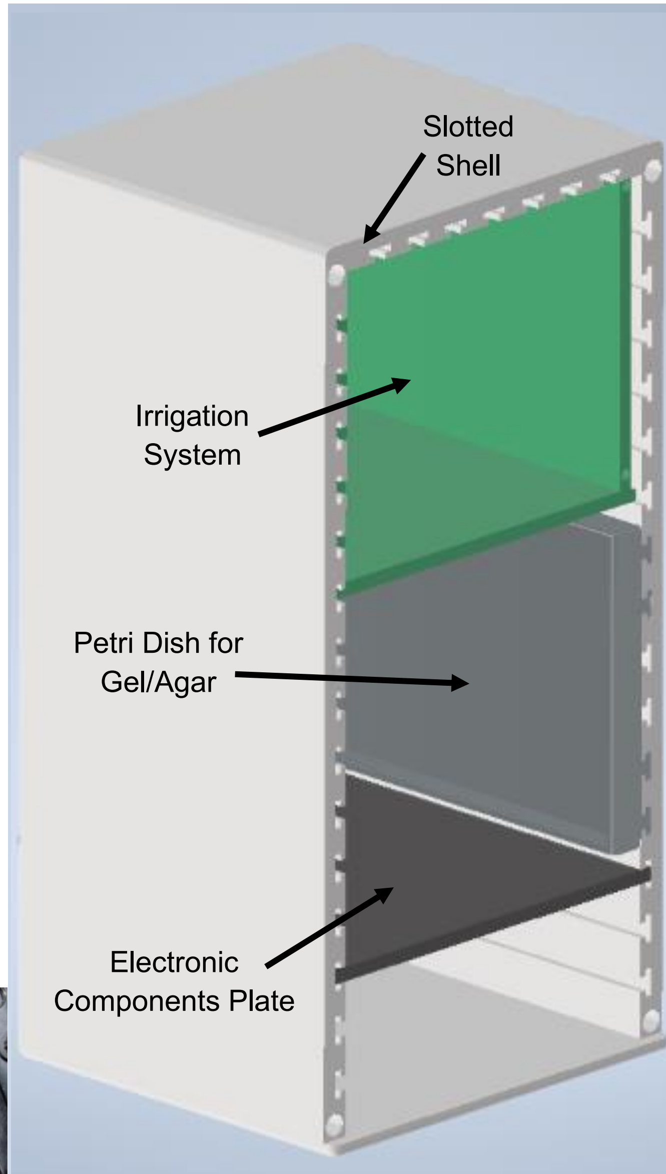
Congratulations for being chosen to receive an Honorable Mention for NASA HUNCH Design and Prototype 2021. This is to provide more praise for those who have done significant design and testing. Take pride in knowing that your work demonstrated many significant innovations and ideas. HUNCH recognizes 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.

NANOLAB

Introduction to Nanolabs: Nanolabs are self-powered autonomous devices that are used for experiments and research on the International Space Station (ISS). The Nanolab we created specifies in agricultural research, creating a custamizable habitat for plants grown in microgravity to be researched. Although the technology for these labs already exist, the labs are often very specific and only compatable with the plant/experiment they were designed for.

Problem Statement: Our group is tasked to produce a Nanolab that can be used for a wide variety of agricultural experiments involving different plants, substrates, and variables on the ISS. As we continue to venture farther into space we need to become less reliant on Earth's resources. Furthering our knowledge of agriculture in microgravity through experiments utilizing a customizable nanolab will allow us to achieve this goal.



CONTACT INFORMATION

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CUSTOMIZABLE NANOLAB

CLEAR CREEK HIGH SCHOOL: BRYAN LAM, DONOVAN LE, JACOB SALAZAR, KARINA NERENG

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RESEARCH

- **Understanding the effects of fluid mechanics in microgravity**

  Water conforms to its surroundings. As it floats freely in microgravity, the surface tension attracts water molecules into sphere-like globs.

- **The germination of seeds in space**

  Plants have been found to be unaffected by the absence of gravity. The roots of plants are guided by nutrients, water, and avoiding direct contact from light.

- **Light frequencies favored by various species**

  Red light (640 to 680 nm) and Blue light (430 to 450 nm) are the primary frequencies desired by seedling and flowering plants. The duration of exposure must be easily adjustable due to the variation of species' preference

- **The application of gels and agar**

  Transparent gels and agar have been utilized historically for the visual studies of root growth. The nutrient rich substances will effectively replace water and maximize the effective space within the lab.

- **Effects of humidity and perspiration within a small environment**

  The environment of our experiment must be air-tight to ensure the preservation of the gases and humidity. Many plants can survive in an enclosed environment for years, as long as they are supplied with an appropriate cycle of light.

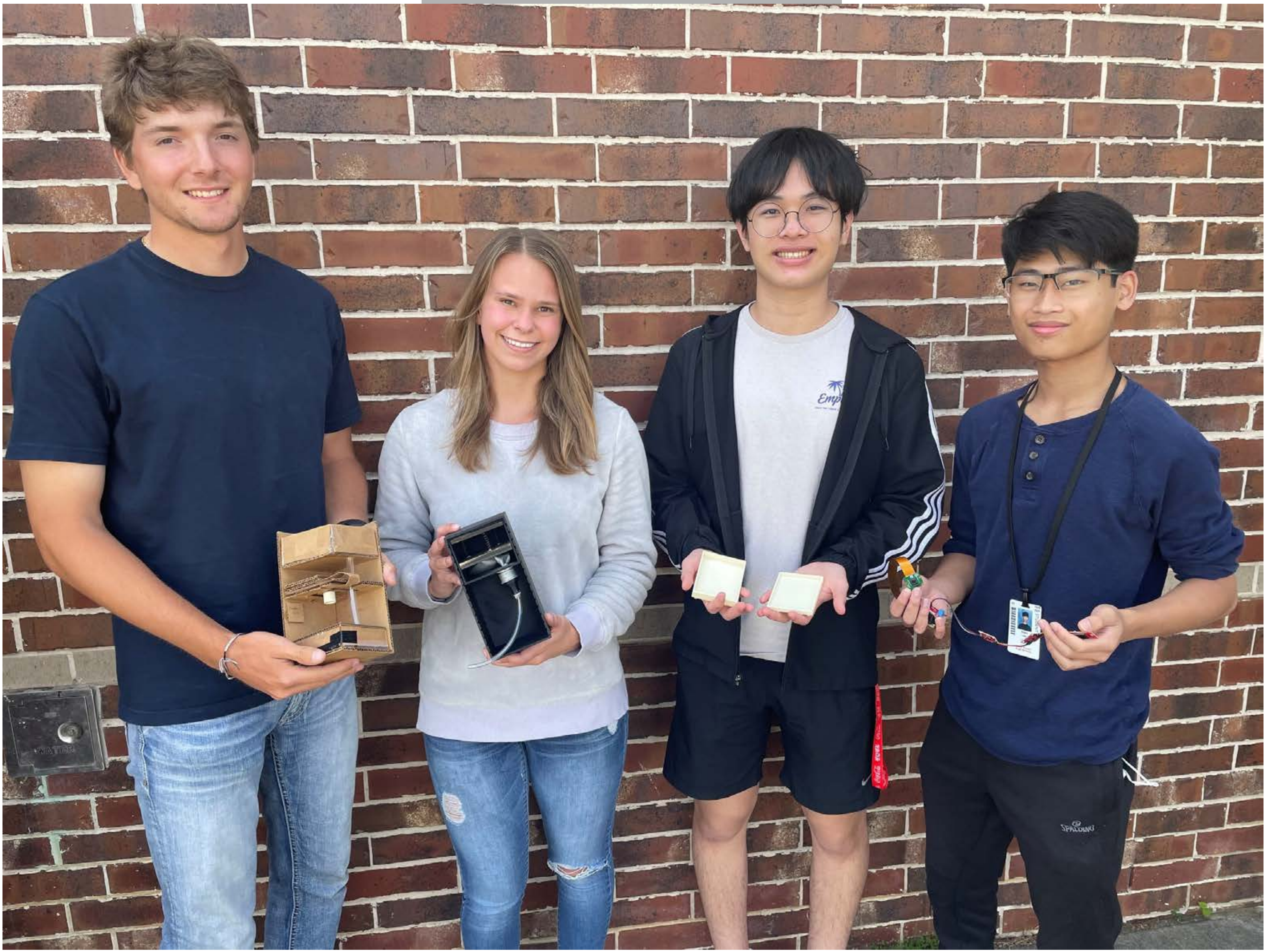
OUR IDEA

We created a slotted shell to allow for movement of the pieces to create a fully customizable experience. A plate containing the lab's electrical components fits into the slots and can be adjusted to increase space for either the plant itself or the irrigation system. If agar or a gel substance is used instead of a soil-like substrate, the irrigation system can be removed entirely leaving more room for the plants or additional components.The lab can support anywhere from 1-6 individual plants, each with its own plant pillow and irrigation hose if required.

ADDITIONAL INFO.

Irrigation: The irrigation system itself is made up of a box containing a durable bag filled with water and a plate resting on top of that bag held in place by tightly compressed springs. A valve on the side of the bag is then opened or closed to water the plant. When the valve is opened, the release in pressure allows the springs to decompress forcing the water down through the hose and into the chosen substrate.

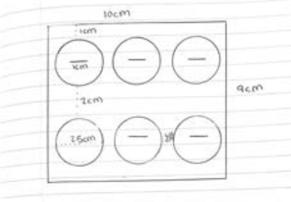
Substrate: Substrate options include plant pillows, which are small packets containing clay substrate mixed with controlled-release fertilizer. The plant's seeds are then attached to germination wicks inside the pillow. Other options include agar or plant gel, which eliminates the need for fertilizer and irrigation as the required nutrients for the plant's survival are contained within the gel.

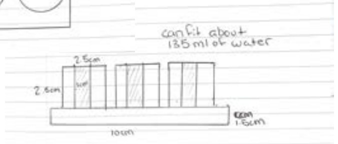

WATER
SPALDING

Agricultural Nano Lab

School: The Fairport High School

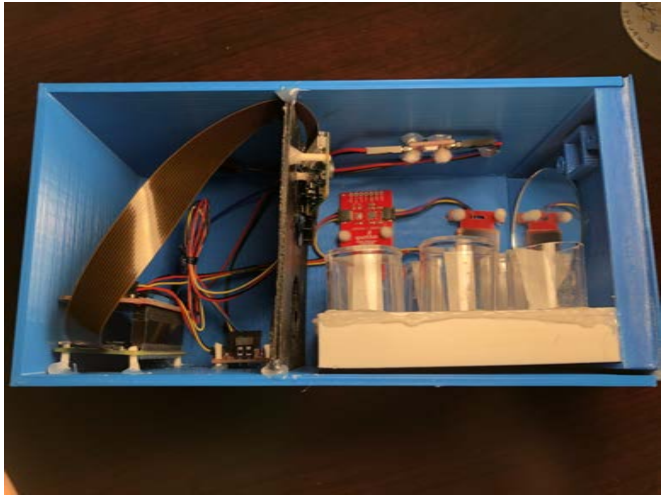
Teacher: Stornello, Himmelberg



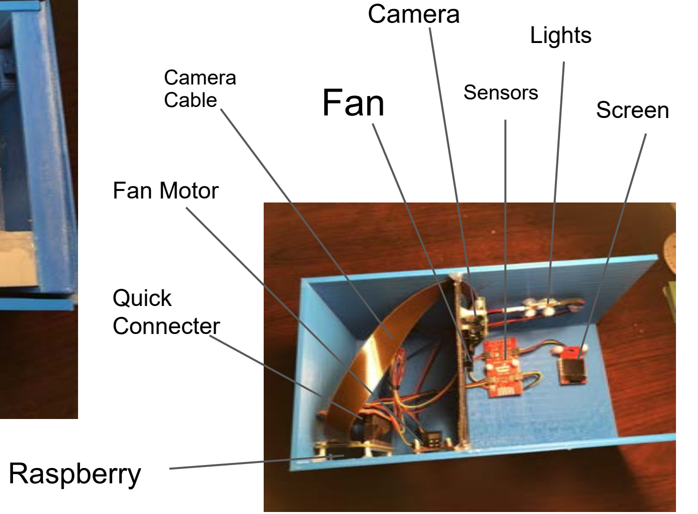


Our watering system is simple and easy to use. The plant wicks are made with filter paper with small pockets to hold the seeds and allow them to grow upwards towards the lights. The filter paper allows for transportation of water without electronics. The watering container, small white rectangle, can hold about 135 ml. The inside of the white box is lined with filter paper so the water can always be absorbed and get to the plants.

Our Nano lab was designed to create a suitable environment for plants to grow in a zero gravity environment.



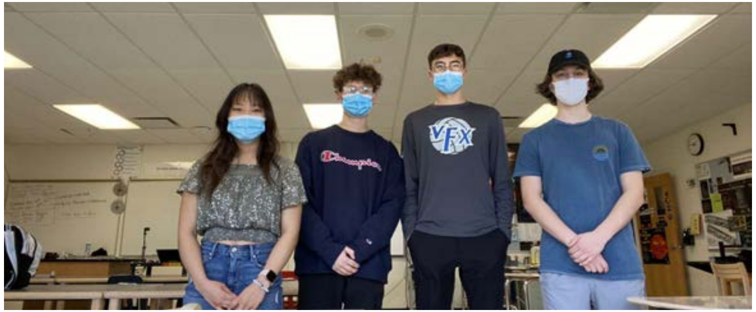
This is the electronics portion of our box. The camera is placed at an angle towards the mirror and the small screen so the pictures sent from the station can have all the data wanted in a simple picture. Plus, The fan wall allows for proper air circulation to the plants whenever needed.



The team:
Ava Drew (Study Abroad)

Kenny Frankovich

Aidan Kearney



Jenna Cameron

Carter Dittman

Process
- Researched plants in space
- Found a suitable substrate
- Created a plausible watering system
- Placed electronics in an orderly fashion

Pros
- Simple, compact design
- Detachable watering system
- Electronics are placed to give all the data in a picture

Cons
- Have not reached the level of desired coding
- Humidity admitted by the plants is not accounted for
- Is not yet fully functioning
- Water is not fully enclosed but the idea is there

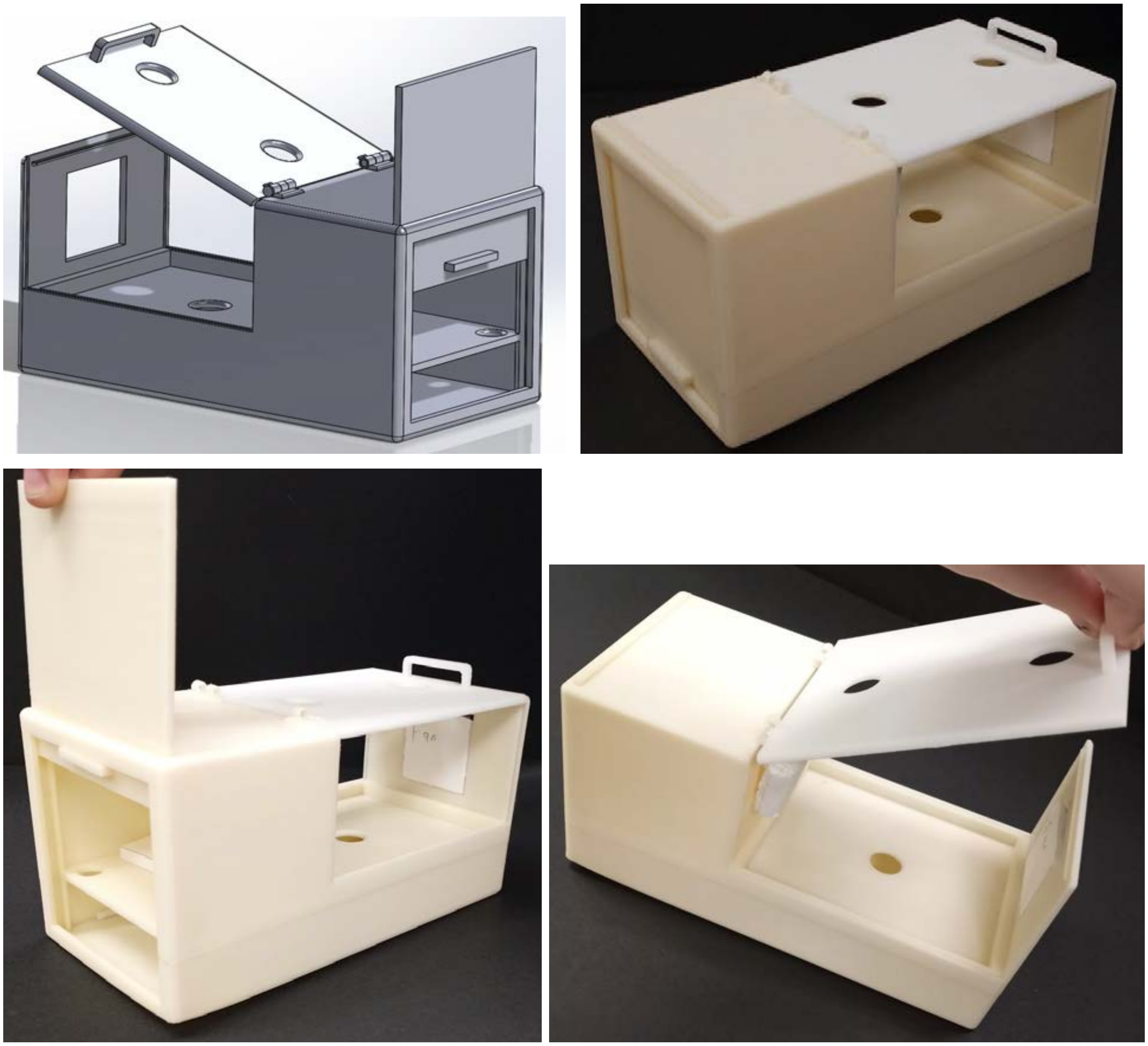
Future Designs
- Use silica beads to account for the humidity
- Use a dry fit material to keep the water enclosed while also allowing flowing air

Critical Design Review

Project: **Generic Agriculture Lab**
School: **Space Coast Jr/Sr High School**
Teacher: **Mr. Luis Reyes**
Team: **Kaya Peoples, Logan Terrones, Colin Wigle, Gabriel Spiegel**

Description:

Our prototype is a 10cm x10cm x 20cm box with room for a plant growth chamber, an air filtration system, a water pump, water reservoir, a fan and LED lights. We met all requirements of the project. The project is compact, fitting within the size specifications, and it will be low power. It also includes a video camera, 4 adjustable LED lights, an area to put a source of water, an area for an air filtration system and of course an area to grow a plant and soil, or whatever the user wants to use. We have a compact design that holds two separate areas, one for air and the other for water both easily accessible via a sliding door on the left side and a central chamber with a trapdoor built into the roof, providing easy access to the plant. There are slots cut into the front and back, enabling windows to be placed into the box, allowing for easy monitoring, aside from the interior camera that can record video and stream it remotely. We also have a full 3D model of our design that can be reproduced.Unfortunately, due to the nature of our project, we don't have any testing data, as that would require more time than we have, as well as a microgravity environment. However, we have reason to believe that the project will be successful and function sufficiently for the entirety of the 30 day mission it is designed for. Our documentation includes a 3D model printable with a 3D printer, as well as the specific components used for the lights, camera, water pump, fan, and computer. Furthermore, our 3D model contains all the necessary measurements to build the design, if another material is desired, making it very easy to reproduce. We created the design with the effect of microgravity in mind, but we do not have a way to test how well it will actually work in those conditions. The project also incorporates Commercial Off The Shelf (COTS) items that make it easier and more cost effective to produce. These items include the camera, computer board, fan, and LEDs.



"Scientist investigate that which already is; Engineers create that which has never been."

Generic Agriculture Lab

School

STEM Academy of Lewisville

Contact Us

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ys6996@students.responsiveed.com

Why our product?

Our goal as a group was to make a compact but effective agriculture lab that could be used to grow plants on the ISS, and while we worked towards this goal, one of the main issues we faced was the need for an irrigation system. Designing an irrigation system that can work effectively in zero gravity is a major challenge, and as a result, we decided to look for unconventional means to solve our problem. Designing an effective irrigation system would require large amounts of time and resources, and it would also take up large amounts of limited space in our final product. We bypassed this step completely through the use of agar gel as a growth medium. This eliminated the need for a complex system to provide water to the plants, thereby saving time, resources, and space in the prototype. One of the other benefits of this change was that we reduced the risk of having a technical failure, as any irrigation system we would have developed would have been very complex, and our groups lack of experience would have made the final product prone to failure. It may not be the prettiest thing, but its revolutionary design allows for specifications to fit virtually every consumer's needs. The NanoLab will surely be a positive addition to any scientist's or agency's arsenal in discovering the wonders of space.

The Nanolab caters to agencies and individuals in need of an experimental planter by focusing on convenience and customization, and sets itself apart by featuring agar gel as a growth medium, hosting different light hues, and requiring little to no prior technical knowledge.

Our Team

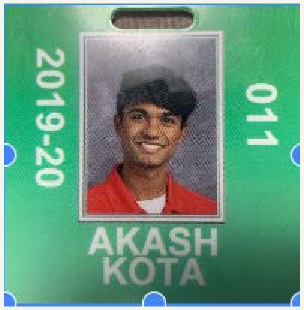
JOSHUA SAITO

Hi my name is Josh, I'm a senior at the STEM Academy of Lewisville. I enjoy fishing and camping.

ADRIAN GARCIA

Hi my name is Adrian, and I am a senior at the STEM Academy of Lewisville. I have a kidney transplant and I got it when I was 7 years old.

AKASH KOTA



Hi, I'm Akash! I'm a senior at the STEM Academy of Lewisville. I like to play soccer, and try new things.

YOANA SHOPOVA

Hello, my name is Yoana and I am a senior at the STEM Academy of Lewisville. I enjoy going on adventures and painting.

Features of our product

- Inner casing for holding agar gel
- Outer casing to keep everything contained and compact
- Agar gel for easy seed planting and zero maintenance
- Customizable lighting for experimentation and maximum efficiency
- A Camera with 64 GB of storage for all your testing needs

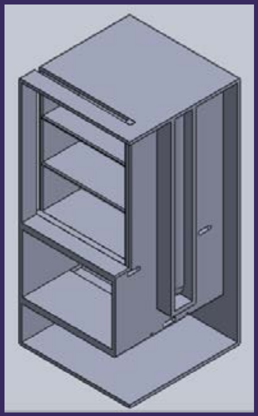
The Problem:

Many people would like to fly a plant growth experiment to the ISS but get discouraged that they have to design the container as well as the experiment. By designing a ***multipurpose botany lab****, NASA could encourage* ***more astrobotany experiments****.*

Design Factors:

The NanoLab should be ***versatile*** *enough to support* ***nearly all small growth and seed studies*** *with only minor adjustments. It should fit within a 10cm x 10cm x 20cm container and provide nutrient media, light, and air for a 30-day mission. It must contain an apparatus to collect data.*

Solution:



- Includes three chambers that are as similar as possible to each other in order that experimenters can vary the experimental variable while keeping all others constant

- Focused on simplicity

- Everything can be customized

- Two walls are removed for clarity in images

Team GARDEN

Logan Carlisle

Specialties:
-Mechanical
- Testing

Sean Carter

Specialties:
- CAD
- Design

Benjamin Fletcher

Specialties:
- Electronics
- Programming

Contact

Joel Bertelsen
jbertels@jeffco.k12.co.us

Chatfield Senior High School HUNCH Program

G.A.R.D.E.N

Generic Astrobotany Research Device for Engineering Nature

Safety and Accessibility Features

Water Safety

- Water tight bag that connects straight to pipe
- Water bag is in its own chamber away from the electronics

-Walls around pipe chamber prevent water leakage

-Entire water system is water tight- if the water chamber fails, the water still can't leave the GARDEN

Different Materials

-Any liquid can be used including gel, water, and any other form of watering substance.

-Any soli can be used

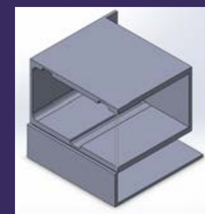
Testing

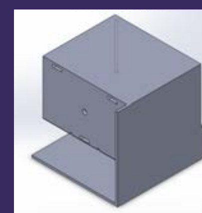
- We have tested the motor and the water chamber head. This test did not involve water or the water bag, only the water chamber head and the motor to pull it. This was a successful test seeing that the motor pulled the water chamber head smoothly. The next step is testing the motor with the water bag with water in it.

Components

Water Chamber

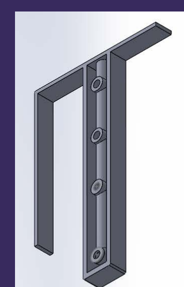
- Where water is stored
- Water chamber head moves across the chamber and compresses the water bag to release water
- Motor in the bottom half drives this motion





Pipe Chamber

- Transports water from input to three growth chambers



Growth Chamber

- Three growth chambers get equal water distribution due to the low gravity environment
- One camera and LED system for all chambers
- Nutrient-rich soil in a

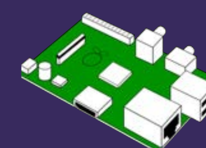
Electronics

Computer

-We decided to use the Raspberry Pi 4 because of the size, user interface, GPIO pins, and camera module.

-To code it we used python, because it is one of the easiest languages to understand.

-In the future we plan to use a GUI interface so customers can easily change variables to fit their experiment. (Variables include amount of time light is on, amount of water dispersed each day, and when the camera takes a picture).



Moving Forward

Full automation

-We are working towards full automation meaning the GARDEN will not need to be tampered with during the mission.

-This includes the motor, lights, and camera.

Water Testing

-We will be testing water in the water chamber and its functionality with the growth chamber

-Water circulation testing

Plant Growth Testing

HUNCH NANO LAB

WHO WE ARE

Teacher: Mr. Manske
School: East Troy High School, Wisconsin
Team Members: Connor L and Xabier B-H
Contact:connorlafreniere22@easttroy.k12.wi.us

AGRICULTURE LAB

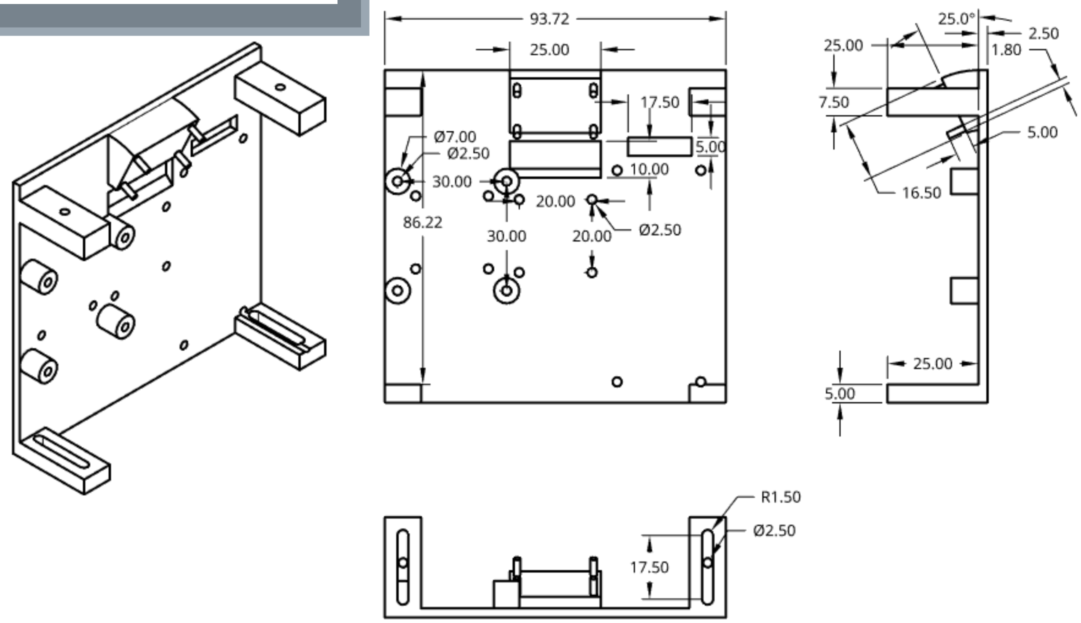
Our group has gone thorough several stages of research and experimentation to get to our current prototype. We began by asking questions about how the plant would grow and what the specific requirements for the lab were. We developed multiple CAD models and 3D-printed three prototypes. We also performed three growth experiments as well. Throughout this season we have broadened our understanding of the engineering and scientific process on our topic.

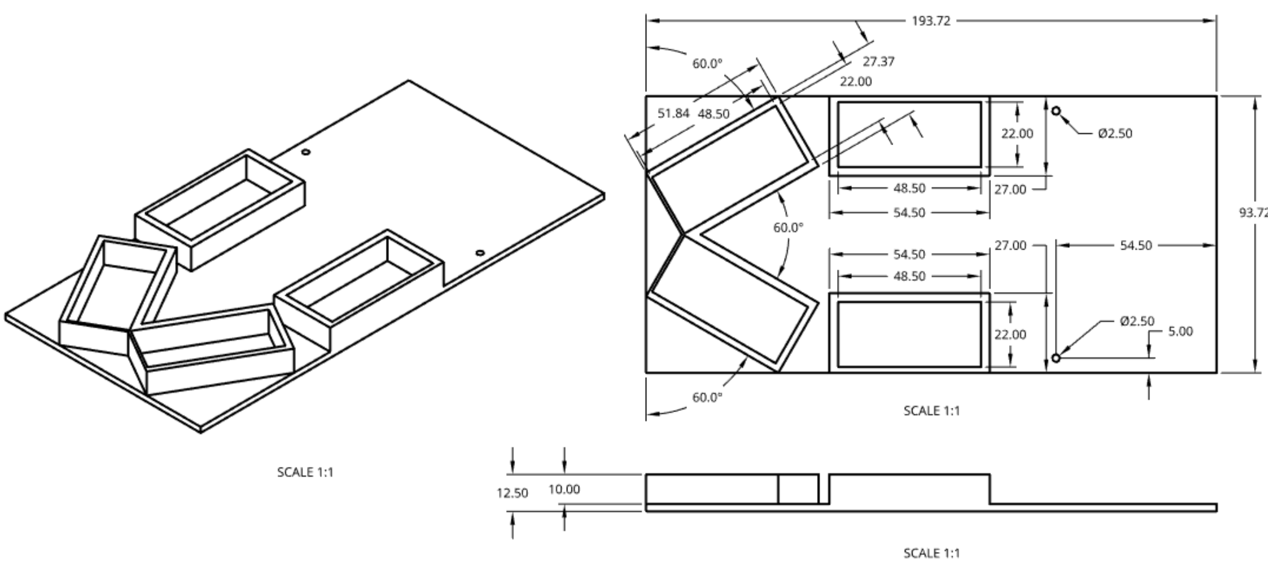
FUTURE PLANS

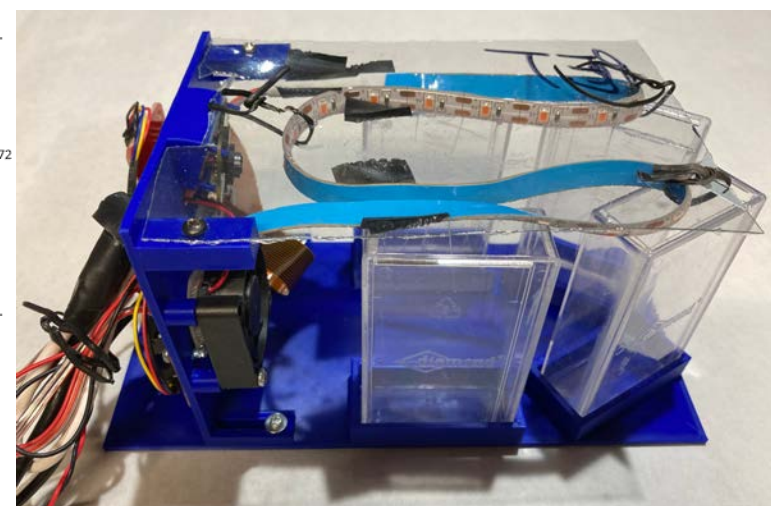
We plan to make improvements on the LED supports, the usability of our code, and better organize our electronics panel.

KEY FEATURES

Our design features 4 separate growth chambers, allowing for separate experiments to be run simultaneously. We utilize a camera to record the sprouting of the captive seeds, an environmental sensor to record data in the lab, and a controller to independently change lights and circulation. We utilize both USB cables, one for power and another to allow data transfer for sensor logs.







Agriculture Nano Lab

Tri-County Regional
Vocational Technical
High School
Frankllin, MA

Mrs. Magas

Sam Chalmers
Geneva McDonagh

Pros

- Versatile
- Made with awareness of microgravity
- Easy to use and manipulate to user's will
- Silent

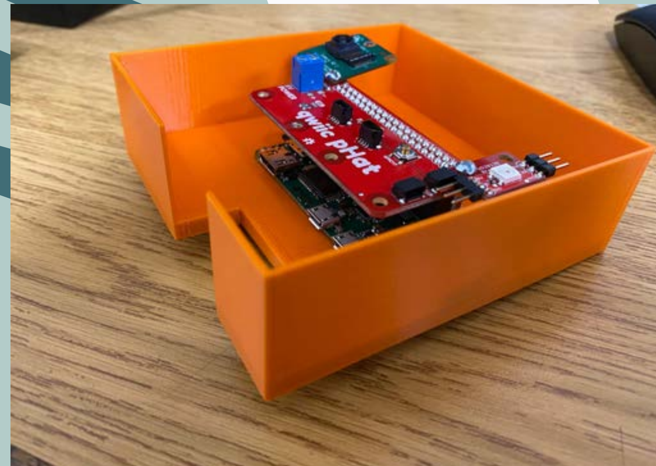
Cons

- Many components
- Each component is reliant on the rest

Images Captured

Design Components

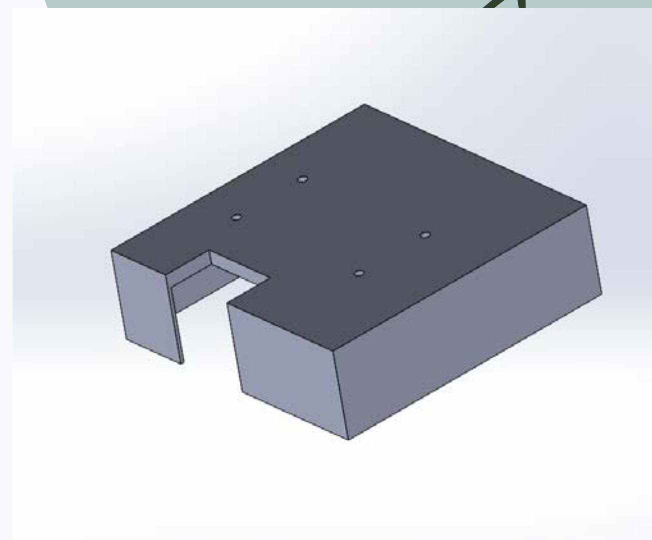
- Bag that can be removed, renewed and installed by user.
- Electronics compartment containing: camera, light, and environmental sensor, and a detachable pouch of silica gel.
- All components are removable and adjustable.
- Lid, keeping electronics and plants separate preventing excess moisture from damaging electronics.
- Plant growth compartment, with tabs to support lid.



Electronics

Complete Design

CAD Model

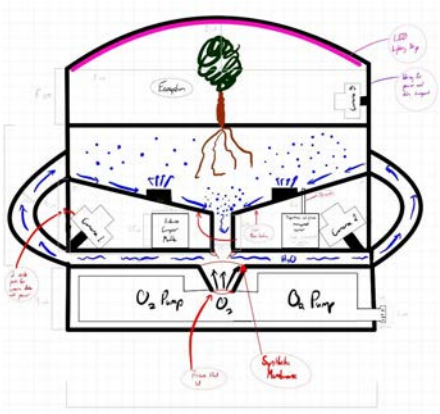


Aeroponics Prototype

Air and water pumped up into the roots

Unused water is recycled using a water concentration gradient

Use mylar to optimize lights



Contact us

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Email: crshunch@gmail.com
Advisor: Mr. Bauer
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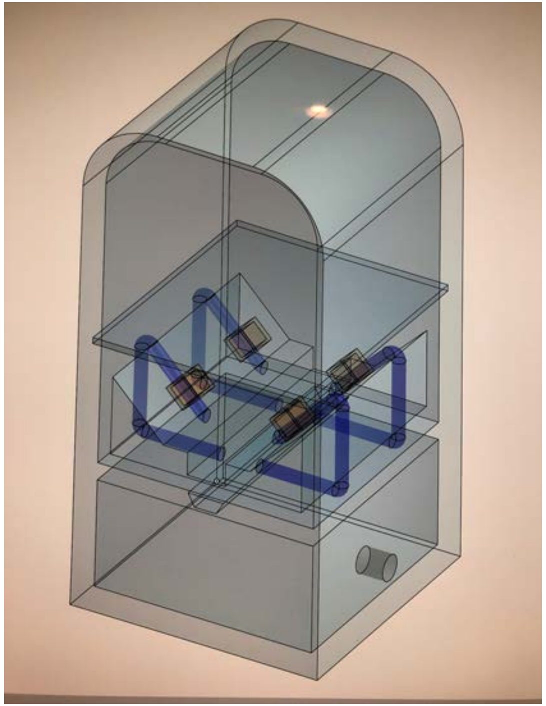
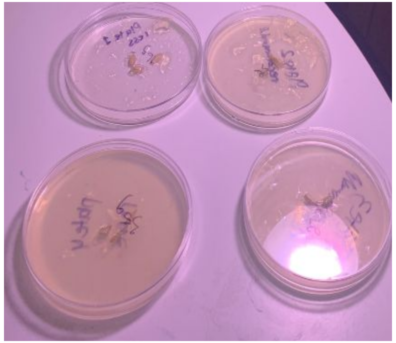
Generic Agriculture



Testing

Due to the lack of sterilization in the cucumber seeds, fungal growth had begun to emerge the 4th day, and continued to grow throughout the rest of the experiment.



Research

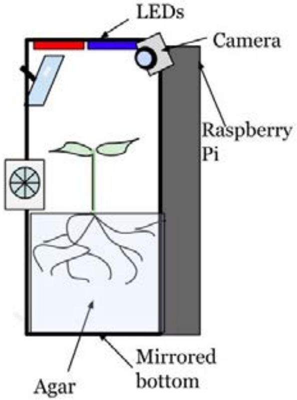
We researched previous experiments of plants growing in zero gravity and different methods of planting: Hydroponics, Plant Pillows, Horizontal Aeroponics, Vertical Aeroponics, Aeroponics, Oasis Foam, Agar, etc.

Agar Prototype

Plant roots grow into agar and absorb nutrients

No water or nutrients need to be added

Fan allows aeration and circulation of air



Ag Nano lab Plant Growth Team

Wyoming Indian High School

Ethete, WY

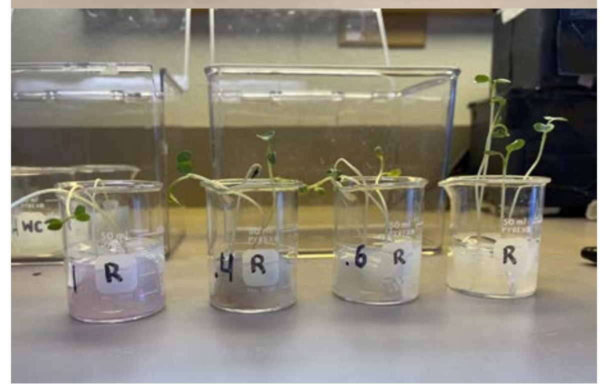
Scott Krassin

Margaret Friday, Arielle John, and Chaunte Redman

Astronauts need fresh food to be able to survive while researching for NASA. We did our part and accomplished to do three research projects which are growing radish seeds in different situations to see which would ultimately contribute to hopeful success .

Team Pictures:

Three images from our three experim

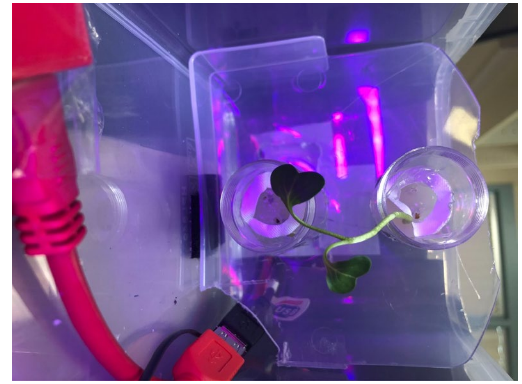


Images Capture

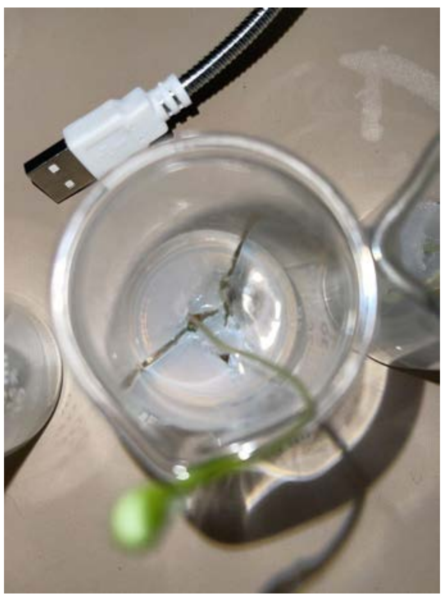
First experiment:

Second experiment:

Third experiment:



First result experiment:



Second results experiment: