Space Station Experiment

Michael Blunt and Morgan Peterson
Palmetto Scholars Academy

Excellence and Innovation
Palmetto Scholars Academy

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Introductions

7 years at PSA

3 years in MD

Project Manager of AR2B Secondary Objective
Intended Major: Computer Science

3 years at PSA

3 years in MD

Outreach Lead of AR2B Secondary Objective
Intended Major: Astronautical Engineering

DETECTS

What is D.E.T.E.C.T.S.

DETECTS

Highschool teams from across the country compete for a research slot on a payload traveling to the **International Space Station** (ISS).

Teams design, engineer, model, build, test, and **present** project proposals to boards of engineers, project managers, and scientists.

The DETECTS competition is hosted by the University of Alabama in Huntsville (**UAH**). The competition is funded by the Space and Missile Defense Command (**SMDC**) and **NASA**.

Excellence and Innovation

Palmetto Scholars Academy

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

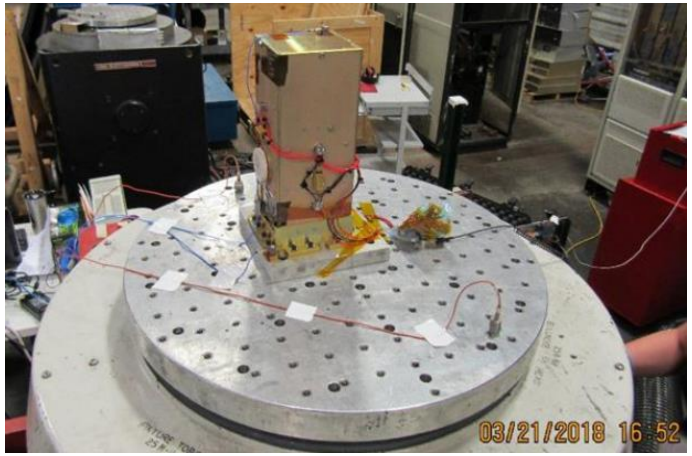
The AR2B Mission

The DETECTS mission is a **secondary** objective, and will be launched alongside a quantum entanglement experiment studying space satellite communications.

- The entire mission is called AR2B.

Objective of DETECTS:

- Find viable low cost equipment to replace current expensive equipment.



https://space.skyrocket.de/doc_lau/falcon-9.htm

DETECTS

Deliverables

As part of the evaluation process, teams were required to complete the following over 12 months:

- Progress Report Presentations (6x)
- 10 page formal reports (2x)
- Board Reviewed Presentations (2x)
- Create Outreach Platform & Content (12 Required Topics)
- Collect Online Outreach Data (500+ Surveys)

The Mission Design Process

Requirements and Limitations

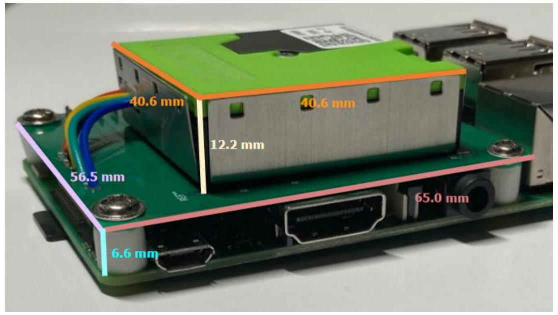
Requirements:
- Understand different engineering and design requirements.

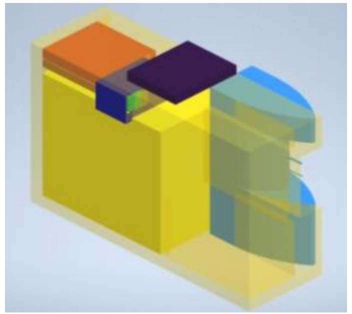
Solutions:
- Identifying needed equipment.
- Applying understanding of requirements during design process.

Ramifications:
- Technical documentation.
- Real world engineering ramifications.
- Technical communication to large audiences.
- Verification of requirements to boards.

Project Requirements	Functional Requirements
• Be under 10 kg • Volume when stowed: 44 cm x 24 cm x 28 cm • Survive environment • No harm to main spacecraft • Access to the data delivery system	• Deploy • Take Measurements • Collect Data • Provide Power • Send Data • House Payload

Environmental Requirements	Science Requirements
• Withstand 462°C • Withstand sulfuric acid • Withstand high atmospheric pressure (up to 91 bar) • Withstand winds 700 km/h	• Complete Science Traceability Matrix • Complete Instrument Requirements • Complete Support Equipment Requirements





DETECTS

Selecting Objectives

Requirements:
- Select a science objective for your payload.

Solutions:
- Create Potential Science Objectives.
- Create weighted figures of merit.
- Research proposed objectives.
- Use trade studies to evaluate.

Ramifications:
- Research skills.
- Team-based communication skills.
- Standardized evaluations.

FOM	Weight	Material Reflectivity		ACES RED 2B Contaminants Comparison		Fiber Optic Radioactivity	
		Raw	Weighted	Raw	Weighted	Raw	Weighted
Interest of Team	9	3	27	9	81	3	27
Measurement Method	9	9	81	9	81	3	27
Likelihood of success	9	3	27	9	81	3	27
Sensor Complexity	3	3	9	9	27	3	9
Sensor Resolution	3	3	9	9	27	3	9
Scientific Ramifications	1	3	3	3	3	3	3
Justifiability	9	1	9	3	27	3	27
Public Comprehension	1	3	3	3	3	1	1
Public Interest	1	3	3	1	1	1	1
TOTAL			171		311		131

Building Experiments

Requirements:

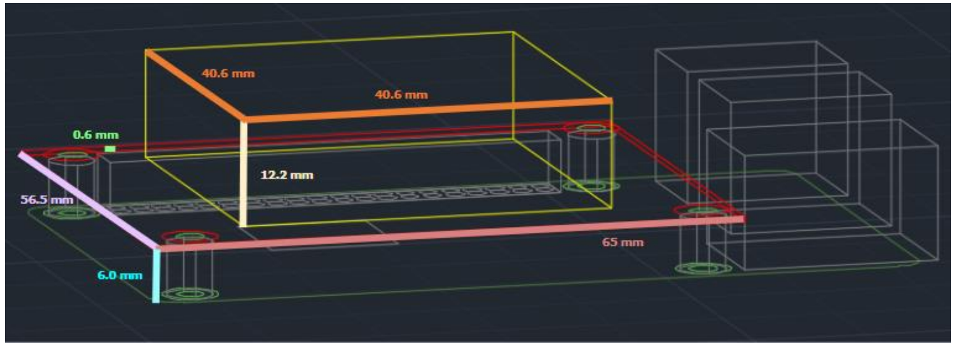
- Prototype a payload that fulfills all requirements.

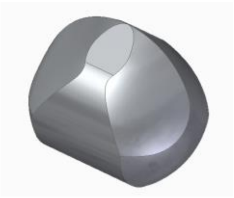
Solutions:

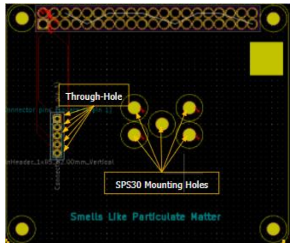
- Iterative design process.
- Modeling and Simulation.
- Physical assembly and advanced construction.

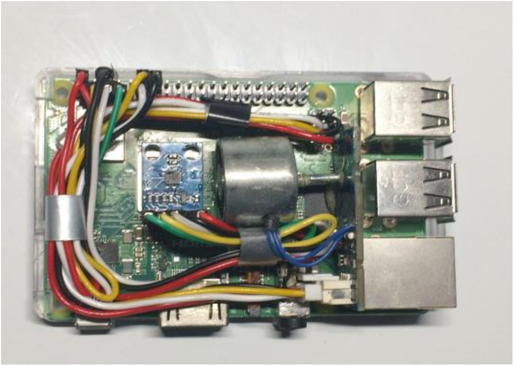
Ramifications:

- Application of our requirements understanding.
- Industry software proficiency.
- Knowledge of hardware.









DETECTS

Revisit Design Process

Requirements:

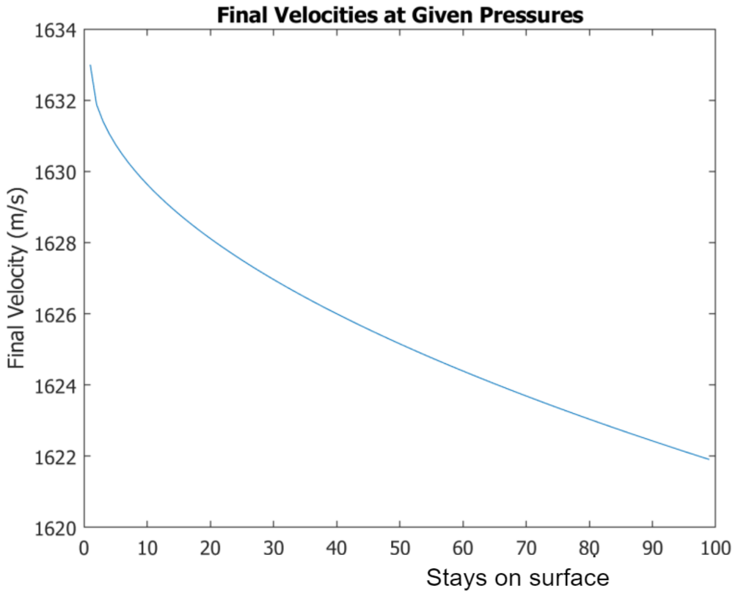
- Refine design based on physics and engineering analysis.

Solutions:

- Utilization of high-level mathematical formulae.
- Understanding relationship between assumptions and outcomes.
- Organized and repeatable mathematical proofs.

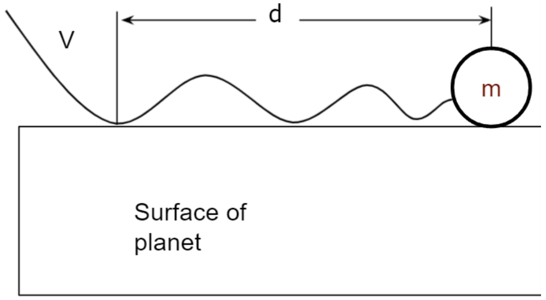
Ramifications:

- Applied mathematics proficiency.
- Creativity in overcoming challenges.
- Describing findings coherently to all audiences.



$$v_f^2 = v_i^2 + 2ad$$

$$v_f = v_i + at$$



Activities for Community Engagement (A.C.E.)

A.C.E. Outline

A.C.E:

A.C.E. is embodied by four elements:

- Identity
- Outreach
    - Create and run an online platform over the course of the competition
    - Complete Content Checklist
- Events + Surveys
    - Plan, host, and run at least 3 Outreach Events
    - Collect and analyze data on:
        - Science Liking
        - Science Importance
        - Math Liking
        - Math Importance
- Effort
    - Your ACE must be "successful"
    - Exceed minimum requirements

Excellence and Innovation
Palmetto Scholars Academy

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Identity

Requirements:

- Design and create a team identity consisting of of a name, slogan, and logo

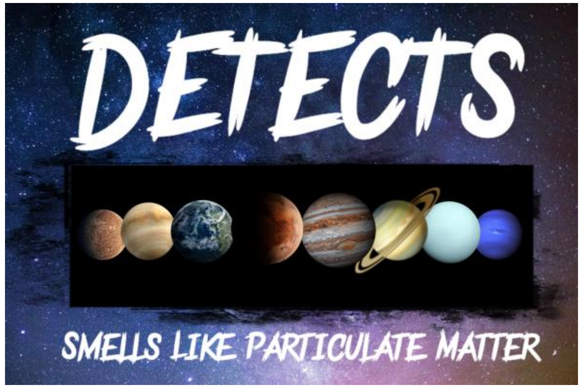
Solutions:

- Create an identity that connects to the mission in some way
- Use inspired ideas from pop culture or scientific fun facts about the mission

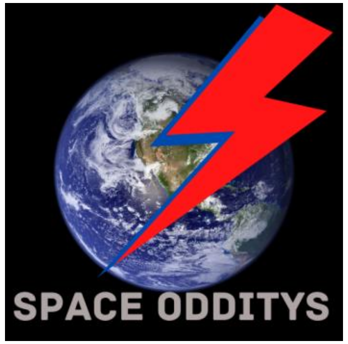
Ramifications:

- Logo marketing to audiences
- Communication of an identity and idea

Oh, such a timeless flight
-
Elton John



"[Our] goal is simple. It is a complete understanding of the universe, why is it as it is and why it exists at all"
-
Stephen Hawking



"For here am I sitting in my tin can, far above the world"
-
David Bowie

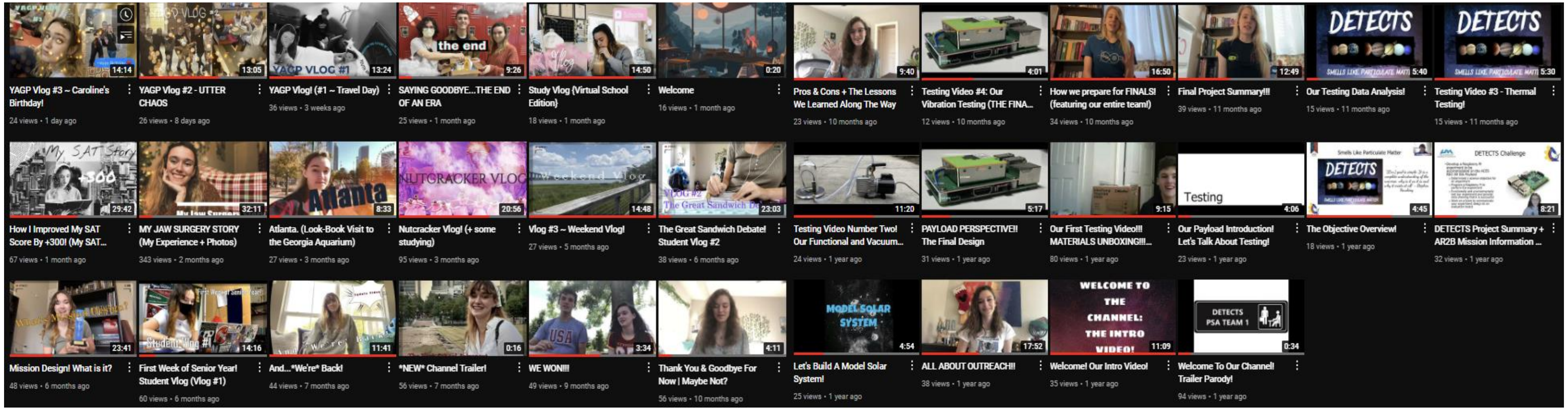
DETECTS

Outreach

Our goal was to create an online presence to engage and inform viewers about DETECTS and our team. This will be done by sharing both informative and fun videos on our main platform Youtube.

Our platform choice was based on our contents topic, targeted demographic, team dynamic, ability to have creative freedom, and the popularity of the platform.

At the end of the competition we had created 18 videos specifically for DETECTS.



Outreach

Requirements:

- Through the use of social media platforms, introduce facts about our mission, our team, and about STEM

Solutions:

- Create social media accounts using our team identity
- Come up with and create interesting posts and videos
- Collect surveys from followers and viewers

Ramifications:

- Use of social media analytics through business accounts
- Introduction to online media marketing and coordination





Events

Requirements:

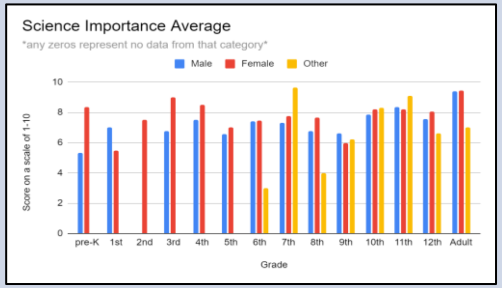
- Host in-person events in which we introduce our audiences to Mission Design, STEM, and Aerospace Engineering

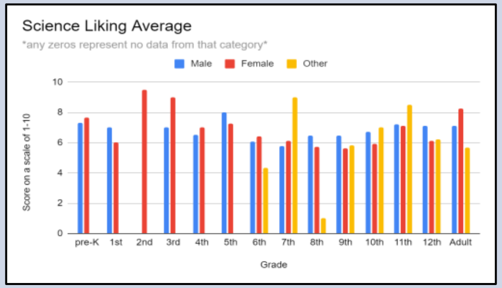
Solutions:

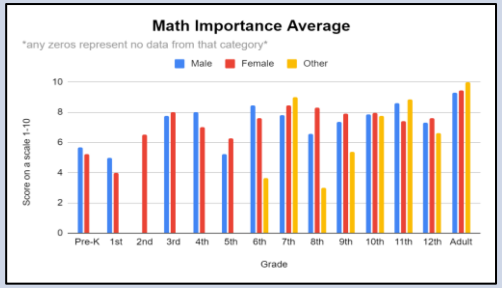
- Use fun experiments to introduce audiences to the topics of STEM
- Create a poster board which we can use to explain various aspects of our mission

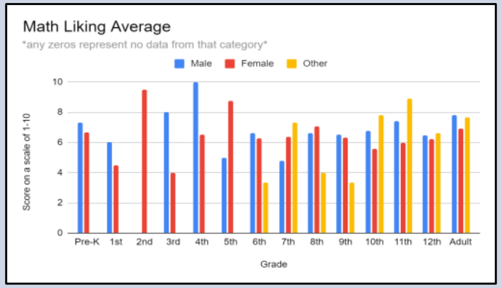
Ramifications:

- Communication to in-person audiences
- Interactive presentation skills









Effort: End of Competition Platform Analysis

End of Competition Statistics:

481 Views

- Most view traffic came from Channel Pages and Browser Recommendations
- All our viewers were from the United States of America
- Our viewers all fell into the 18-24 age category
- It was 50-50 between our viewers being subscribed and unsubscribed

12.7 Watchtime (Hours)

24 Subscribers

2,599 Impressions

Highest Performing Videos of the Competition:

- Our First Testing Video (Materials Unboxing)
- Thank You & Goodbye for Now
- We Won!

My Channel Now

Current Channel Statistics:

1,580 Views

- Most view traffic came from Channel Pages, Browser Recommendations, and Youtube Search
- The channel has viewers in the United States, Austria, and the United Kingdom
- Viewers still fall into the 18-34 age category
- Audience is primarily Female

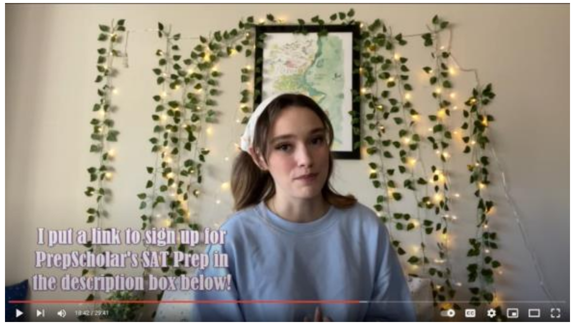
62.7 Watchtime (Hours)

49 Subscribers

14,062 Impressions

My highest performing videos to date:

- My Jaw Surgery Story
- Nutcracker Vlog
- Our First Testing Video (Materials Unboxing)
- How I Improved My SAT Score



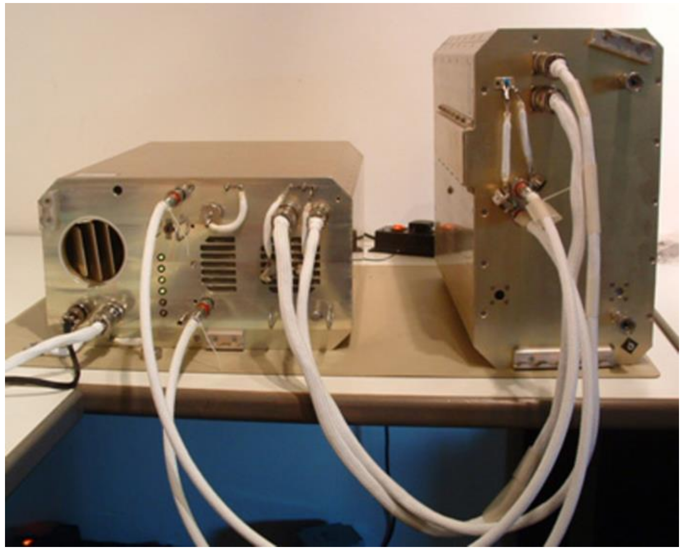
Our Project

Palmetto Scholars Academy — Excellence and Innovation

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Research/Problem

- **Research Question**
  - What is the difference in both quality and quantity of measurement between consumer and professional-grade sensing technology?
- **Hypothesis**
  - Laser based consumer-grade particulate matter sensors are more accurate than existing professional-grade infrared particulate matter sensors.
- **Research**
  - ANITA, developed in the early 2000s for ISS
  - > 0.7 µm (high parts per billion) - Infrared
  - > 0.3 µm (low parts per billion) - Laser



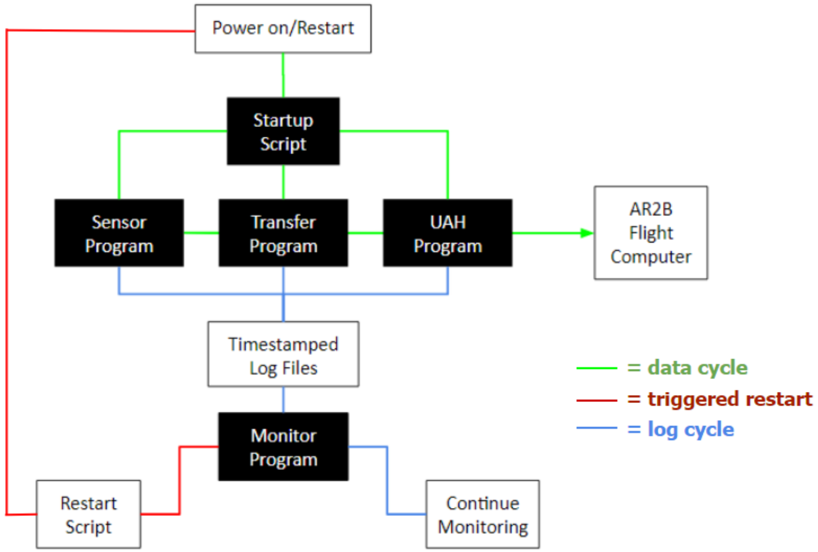
DETECTS

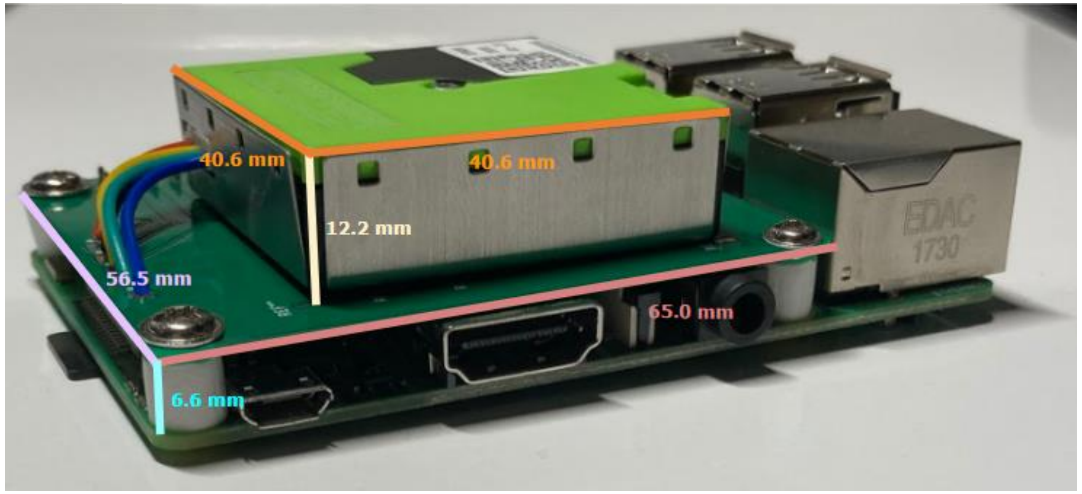
Process Summary

We spent the first six months of our project designing and building our experiment. This included:

- Researching
- Programming
- Modeling
- Integrating
- Assembling

The remaining six months were spent testing and perfecting our experiment.



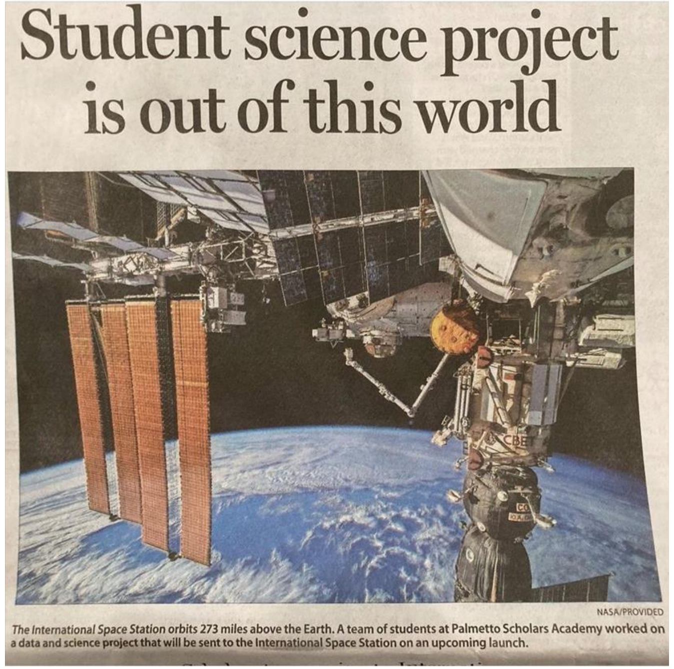


End Result

We were given a final review score of 99.7%, and were selected as the only experiment travelling with AR2B.

- We were published in the Post and Courier, and made the front cover.
- Many members of the local community saw this article, and it has helped create awareness of the opportunities STEM competitions in high school have to offer.

Figure 1: ACES RED Experiment #1 Frame



Student science project is out of this world

NASA/PROVIDED

The International Space Station orbits 273 miles above the Earth. A team of students at Palmetto Scholars Academy worked on a data and science project that will be sent to the International Space Station on an upcoming launch.

...olars team going to International Space Station

Michael Blunt, an incoming senior at Palmetto Scholars Academy, tests his payload experiment in a toaster oven. The experiment will be sent to the International Space Station.

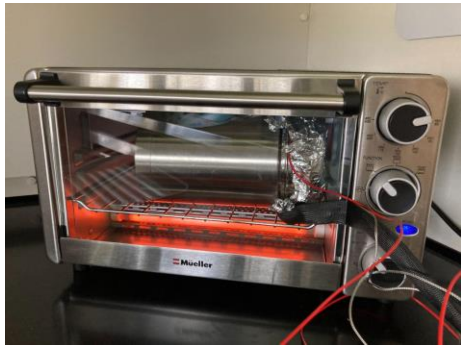
MORGAN PETERSON/PROVIDED

The project will be attached to a payload, which is NASA's name for items, or people, sent into space.

Once there, the experiment will collect data on the use of "commercial off-the-shelf equipment" as materials in space. If the data backs it up, the students' experiment could save NASA billions in material costs.

"The current space-grade equipment can be very, very, very expensive, we're talking billions of dollars," said Michael Blunt, an incoming senior at PSA and team leader of the project. "But some of the commercially available equipment is very cheap in comparison."

Please see **EXPERIMENT**, Page A4



Tools for the Future

Michael:

- Early leadership experience will allow me to perform as a more experienced leader in future situations.
- CAD and programming knowledge will be incredibly useful as a CS major.
- This project and standardized tests have opened doors for college, scholarships and more.
- Understanding how to write and read technical documentation is key in a technical field like computer science.
- Communication skills taught in mission design have taught me effective public speaking and team management.



Morgan:

- My leadership experience will has made me a prepared and experienced leader in not just general leadership settings but also in a virtual settings.
- ISS project and Youtube Platform have opened doors for college and special awards
- Understanding how to plan and create content designed for a target audience to complete a certain objective is a skill I can apply to any career path I choose to pursue in the future.
- Communication skills taught in mission design have taught me effective public speaking and team management.