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# The Embedded Teacher Program

A Design-Build-Fly Parabolic Research Experience for Title I Middle Schools

Kevin Crosby

Wisconsin Space Grant Consortium

Next Generation Space Researchers Conference

Broomfield, CO

February 27, 2023

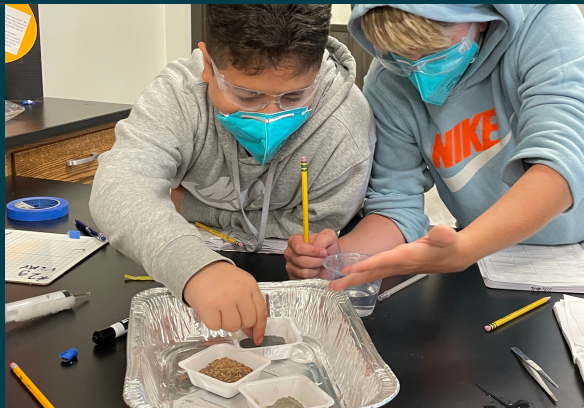
# Space Research is for Everyone

bring it to your classroom  
bring it to your community  
share it with the world

The Embedded Teacher Program.

An immersive microgravity research experience.

<https://spacegrant.carthage.edu/educators/embedded-teacher-program>



## Student Designed

- Authentic scientific research
- Exceptional STEAM engagement
- Real career-readiness skills

## Student Built

- Integrated across disciplines
- Inclusive team driven environment
- Accessible to all

## Student Tested

- Sustainable curriculum model
- Scalable programing
- High visibility

## Teacher Flown

- University and industry involvement
- Student to student mentorship
- Global outreach



# Program Overview



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### Pseudo-Satellite Movement Through Angular Momentum in Zero Gravity



The pseudo-satellite is a device to test the efficiency of angular momentum in navigating satellites. This technology could be used to return satellites to earth, so long as one of the motors is placed near the edge.

The satellite create it's angular momentum by spinning large diameter tires by a fast motor, creating a rotational kinetic energy that will spin the satellite and position it during the experiment.



Workshop



Project Proposal



Design and Testing



Flight



Curriculum  
Publishing



Media and Outreach



ISS Extension



Sustaining



# Objective



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Move the needle on STEM persistence by changing perceptions of STEM and space career accessibility and relevance.



Middle school is where STEM interest peaks and declines rapidly, particularly among girls and underrepresented students.



Research/Inquiry is the single-most effective tool to combat STEM engagement decline.

Space is the hook for STEM engagement





# Workshop



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## Competitive Teacher Selection Process

### Two Day Workshop Covers:

- Hands-on Activities
- Microgravity Platforms
- Commercial Providers
- Suborbital Research Community
- Teaching NGSS content through space
- Proposal Development
- Guest Speakers:
  - Commercial Providers,
  - biological, medical, and fluids researchers









# Teachers Teaching Teachers



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Teacher Mentors (Left to Right):  
Ronda McCarthy, Des Moines IA, Laura Tomlin,  
Salado TX, Lisa Werner, Dousman WI, Becky  
Busby Hinesville, GA



Lynne Zielinski, VP  
Education, National Space  
Society. Coordinates ETP  
workshops

Our award-winning educators are mentors for the Zero-G Embedded Teacher Program, International Teacher Liaisons for the Space Foundation, Solar System Ambassadors, and U.S. Ambassadors for One Giant Leap Australia.

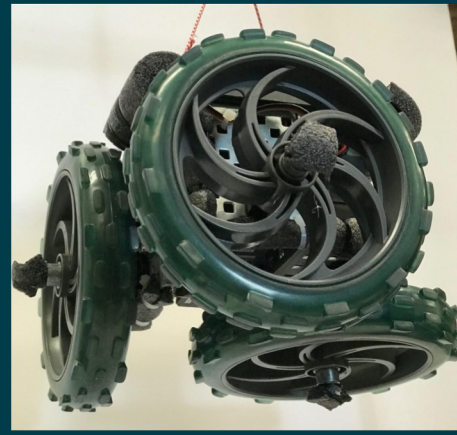
# Student Designed and Built



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Liquid Acquisition Designs



LEGO Mindstorm Satellite  
ADC



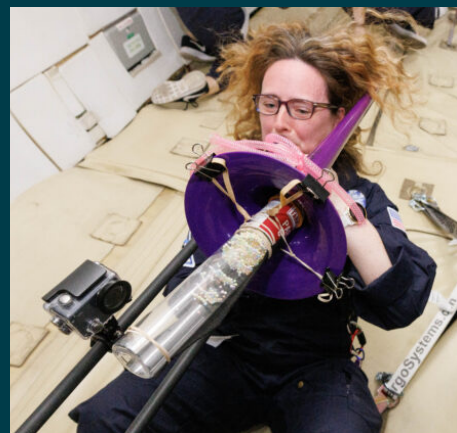
Water uptake in Lunar, Martian  
Regolith Simulants



Navigation cues for the  
visually disabled



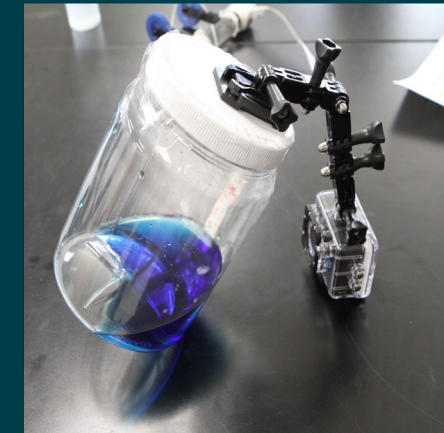
Liver Catalase Enzyme Activity in  
Microgravity



Resonance and Standing  
Waves



Genes in Space Precursor  
Experiment to ISS Mission



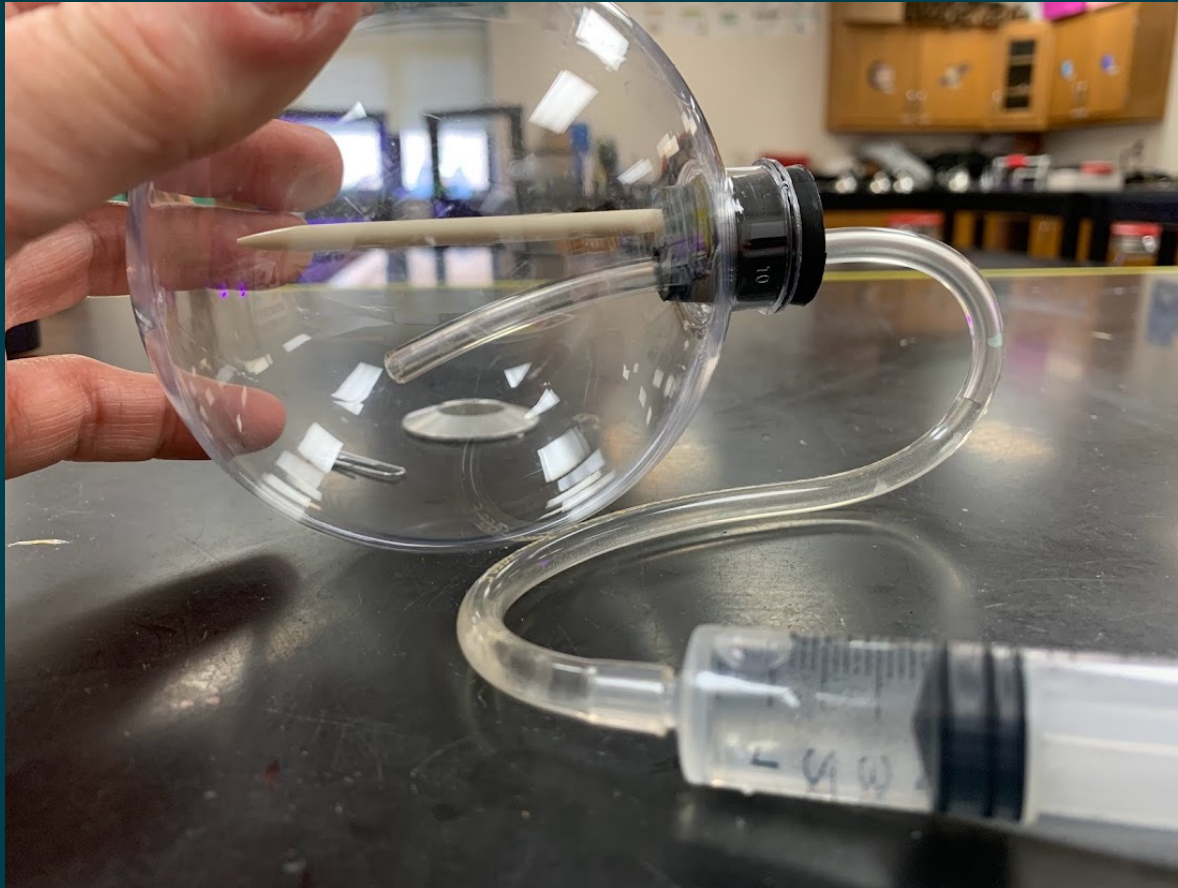
Liquid Equilibrium  
Shapes in Microgravity



# Student Designed and Built



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Reproducing Don Pettit's Electrostatic droplet Orbits Experiment

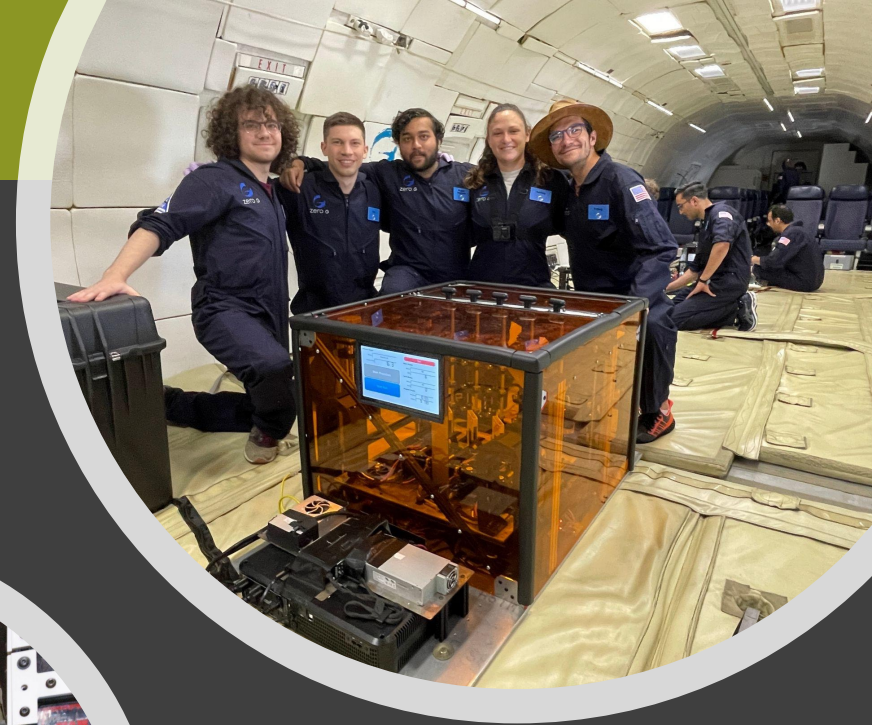


Receiving expert advice.



# Flights!

- Each teacher conducts 2-5 experiments on a parabolic flight, “embedded” with researchers
- ZG provides videography/photography





# Curriculum Modules



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- Each teacher required to develop 1-2 Curriculum modules
- Modules published on NSS *SpacEdge* and *DreamUP* portals



*Examples: Effect of Gravitational Changes on Susceptibility of Cotton Seedlings to Xanthomonas Leaf Spot Disease.*

*Laura Tomlin, Salado Middle School*

*The Effect of Microgravity on Catalase Enzyme Activity in Calf Liver*

*Laura Tomlin, Salado Middle School*

*Full Cup: Why is Surface Tension a Force Parallel to the Interface?*

*Ronda McCarthy, St. Bruno School.*

- One project each year selected for an ISS extension project using NanoRacks MixStix
- Each teacher can include one MixStix-type experiment in the parabolic flight project set





# Impact and Outcomes



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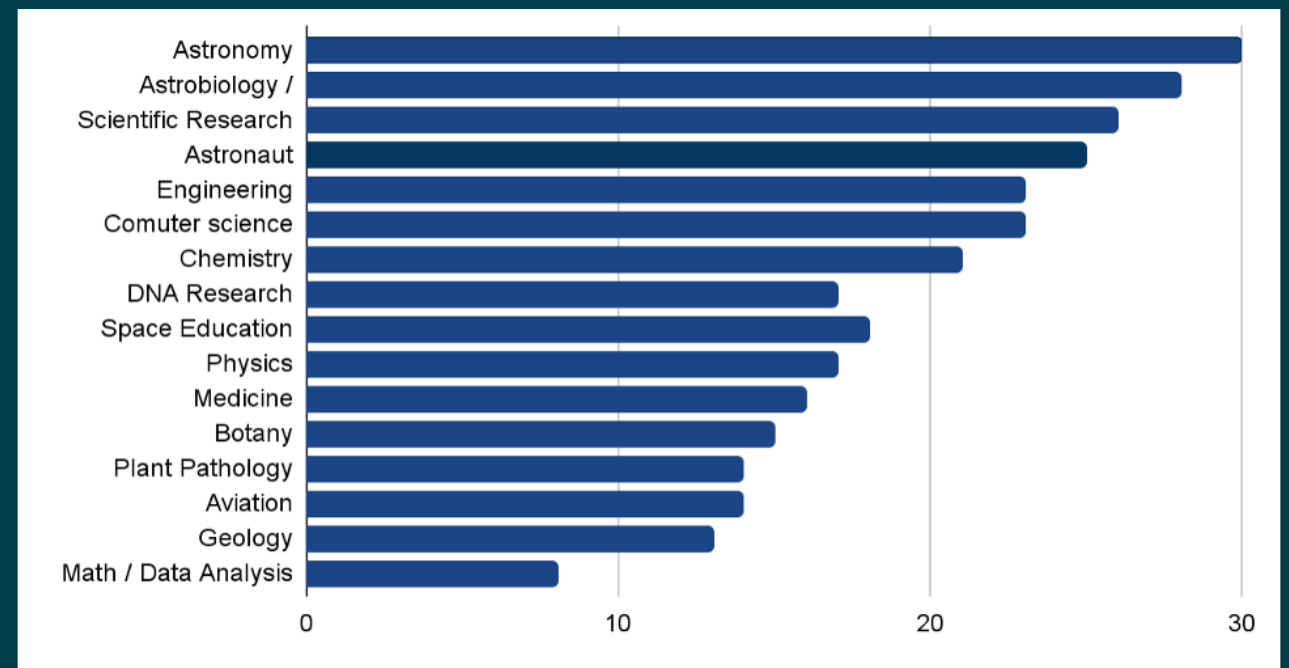
5000+ students directly and indirectly engaged annually.  
Multi-market media exposure for schools and districts  
Sustaining investments in STEM education  
Audience: 1.2M STEM educators in the U.S. 5k+ space educators



Did working with microgravity experiments inspire you to pursue a career in STEM?

60% of 6th grade students were inspired to pursue a career in STEM\* (compare national avg. 35%)

\*N=96 Salado Middle School 6th grade students.



# Sustainability



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- Participants are asked to develop sustainable implementations of workshop/flight experience in their classrooms.
- Implementations vary but common elements are:
  - University partnerships
  - Leveraging existing STEM Space programs (Tomatosphere, Genes in Space, etc.)
  - Use of STEM Clubs (co-curricular after-school groups)



# Partnerships



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# Acknowledgements



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We gratefully acknowledge the support of the NASA Flight Opportunities Program Awards 80NSSC20K0105, 80NSSC21K0339, and 80NSSC22K0580.

Salado ISD (Salado, TX) statement from Office of Superintendent:

*The Embedded Teacher Zero-G program has brought NASA into our classrooms as students engage in genuine research projects. Our students have learned to have deep, thoughtful, research-based conversations with other students, university professors, scientists, and NASA engineers. The program's incredible capacity to build connections and relationships has changed the way our students experience science class. It has taken children who might otherwise be passive or minimally engaged and made them active participants in a network of scientists and engineers. Our students are learning that no matter their personal background, there is a place for them in the world of engineering and technology.*