



INSPIRE - ENGAGE - EDUCATE - EMPLOY

The Next Generation of Explorers



NEXT GEN STEM AND MOON TO MARS STUDENT CHALLENGES

SPACE EXPLORATION EDUCATORS CONFERENCE (SEEC)
FEBRUARY 6, 2021

Agenda

Welcome and Introduction: (2-3 minutes)

- Next Gen STEM and Moon to Mars Overview

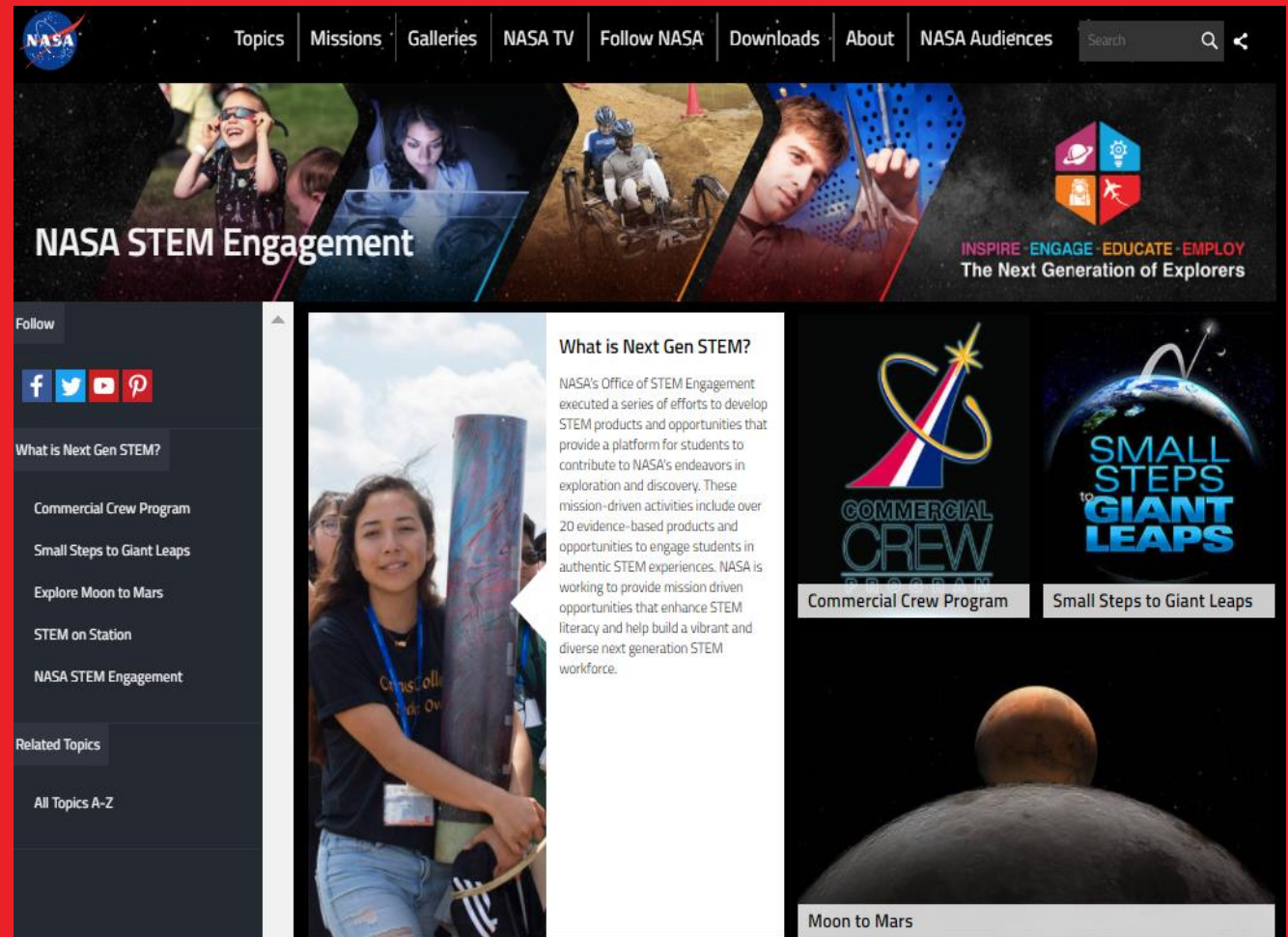
Moon to Mars Student Challenges: (16-18 minutes, 5-6 minutes per challenge)

- App Development Challenge (ADC)
- Human Exploration Rover Challenge (HERC)
- Student Launch (SL)

Conclusion/Wrap-up: (1-2 minutes)

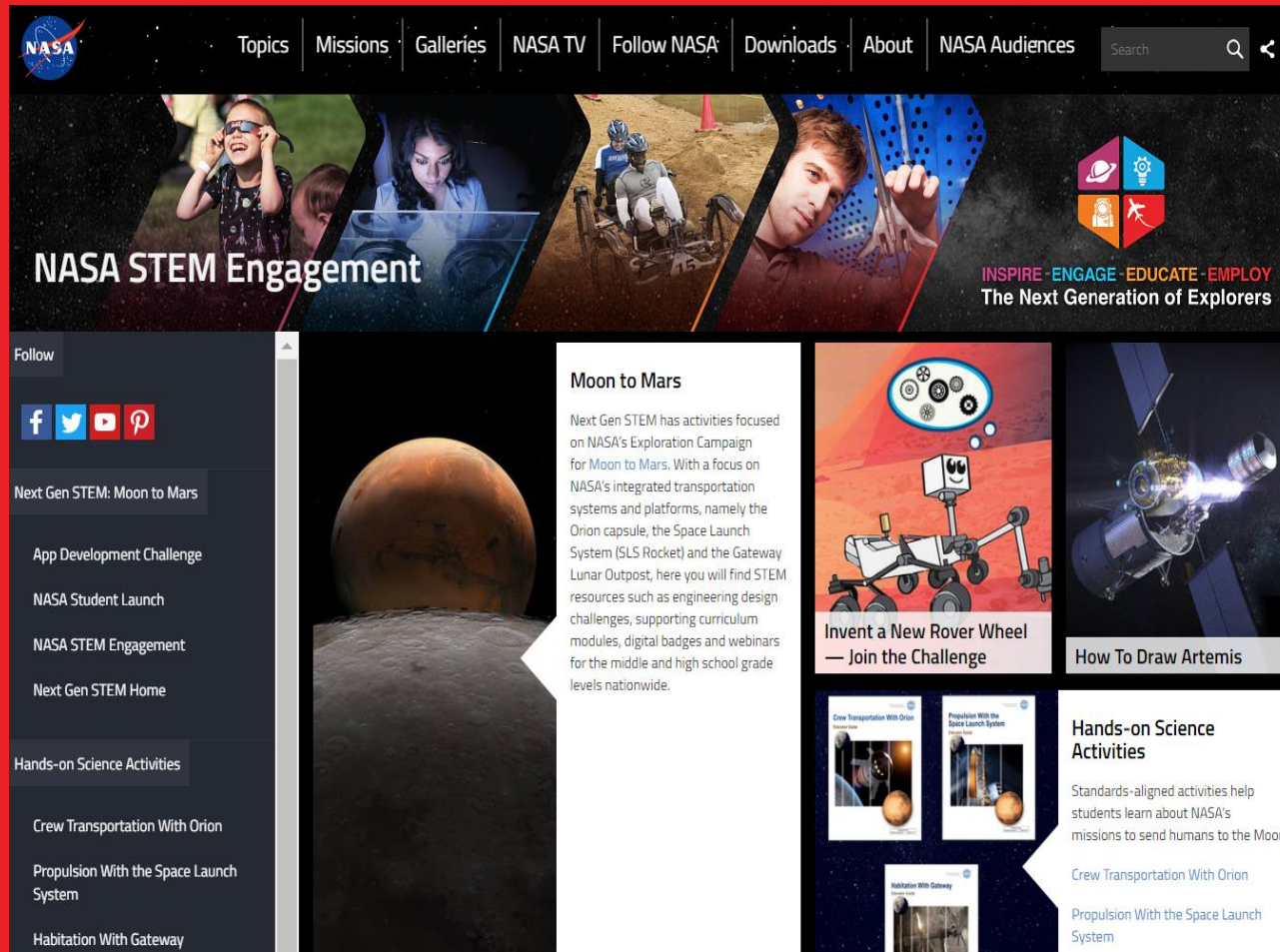
Next Gen STEM

NASA's Office of STEM Engagement executed a series of efforts to develop STEM products and opportunities that provide a platform for students to contribute to NASA's endeavors in exploration and discovery. These mission-driven activities include over 20 evidence-based products and opportunities to engage students in authentic STEM experiences. NASA is working to provide mission driven opportunities that enhance STEM literacy and help build a vibrant and diverse next generation STEM workforce.



<https://www.nasa.gov/stem/nextgenstem>

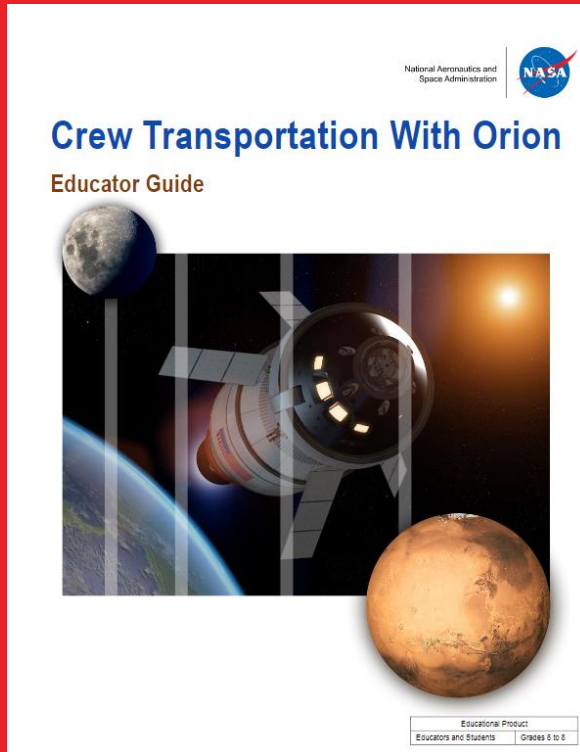
Moon to Mars



Next Gen STEM has activities focused on NASA's Exploration Campaign for Moon to Mars. With a focus on NASA's Artemis Program and NASA's Mars Exploration efforts. Integrated transportation systems and habitation systems for human transport to deep space destinations are the primary focus of the STEM resources and opportunities available for K-12 students and educators nationwide. The components include engineering design challenges, supporting curriculum modules, digital badges, videos, and webinars.

https://www.nasa.gov/stem/nextgenstem/moon_to_mars

Moon to Mars Educator Guides



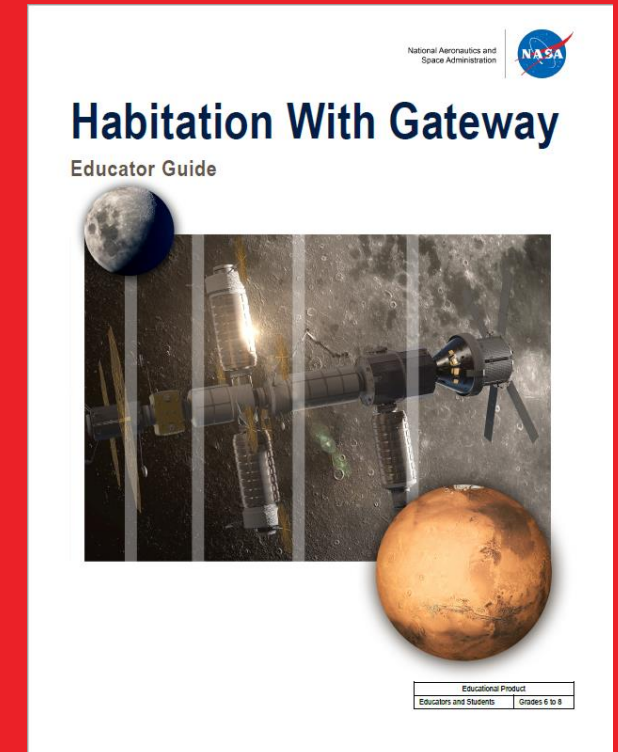
Crew Transportation with Orion

- Analyze the Geometry of a Spacecraft
- Design a Crew Module
- Model a Spacecraft Docking System
- Build a Heat Shield



Propulsion with the Space Launch System

- Design a Foam Rocket with Stabilizing Fins
- Track the Altitude of a Rocket
- Build a Multistage Balloon Rocket
- Optimize a Water Rocket Engine



Habitation with Gateway

- Assess the Structural Integrity of a Space Module
- Design and Build a Space Habitat
- Experiment with Water Filtration
- Test Materials for a Radiation Shield

<https://www.nasa.gov/stem/moontomars>



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Moon to Mars Student Challenges

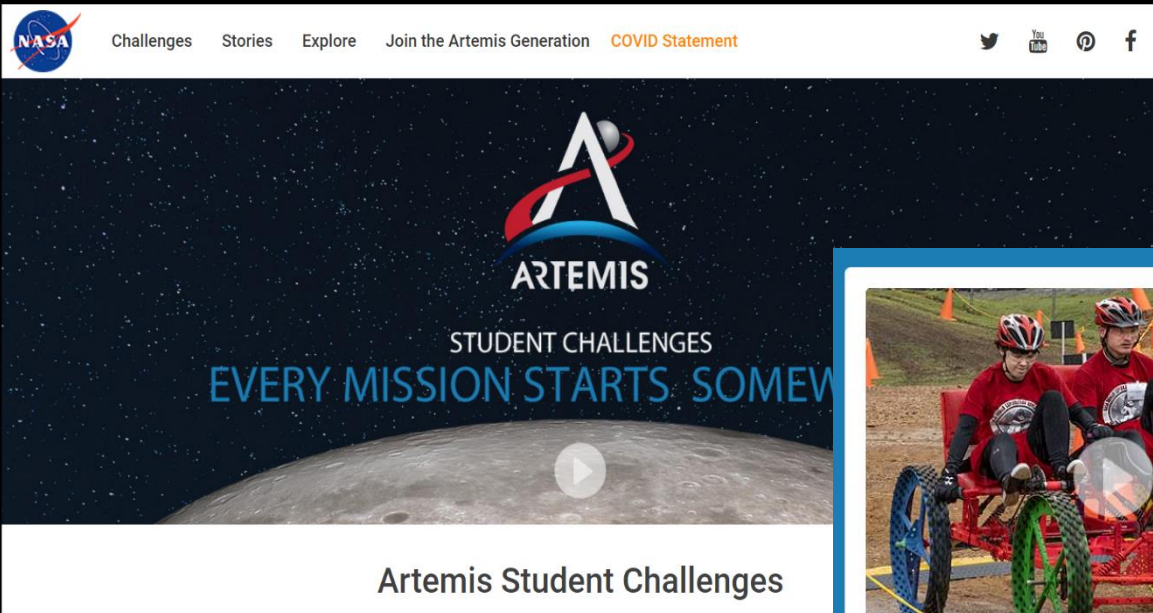


2021
NASA **SL**
Student Launch



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NASA Artemis Student Challenges



Human Exploration Rover Challenge

Create a vehicle and mission (or task) materials designed to traverse and explore the simulated surface of another world.

[Learn More](#)



RMC: Lunabotics

Build a robot to simulate an off-world lunar mining mission.

[Learn More](#)



Micro-g NEXT

Design, build and test a tool or device to address a current space exploration challenge.

[Learn More](#)

<https://stem.nasa.gov/artemis/>



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App Development Challenge (ADC)



In the ADC, teams of middle and high school students use web apps to code solutions to technical problems presented by NASA.

Contributions to the Mission (FY20)

- Provide SCaN with visualizations that directly support upcoming mission planning activities.
- Support SCaN training activities by providing a visualization with constrained lunar data in an area targeted for future Artemis mission exploration.
- Identify possible exploration routes that optimize communication with a lunar satellite or Earth ground stations.
- Provide a mechanism to view consolidated data and validate it against future mission data obtained directly from the lunar surface.
- Use student-designed solutions to engage and educate the nation about the Artemis program.
- Develop STEM skillsets within the Artemis Generation needed for future exploration.
- Inspire communities to become part of the Artemis Generation.





Overview



- In the FY20 challenge teams coded a visualization of the South Pole region of the Moon that displayed essential information for navigation and communication.
- Teams had seven weeks to create an app solution and post a video of their app designs online for consideration by NASA to use in future mission planning activities.
- Teams with favorable submissions were selected to present their app in an interview with NASA SCan engineers and scientists.
- After the interviews, NASA selected Top Teams for a culminating event experience in February, 2021.
- The challenge begins on September 30, 2020 and concluded with video submissions on November 18, 2020.

New FY21 challenge will be available soon!



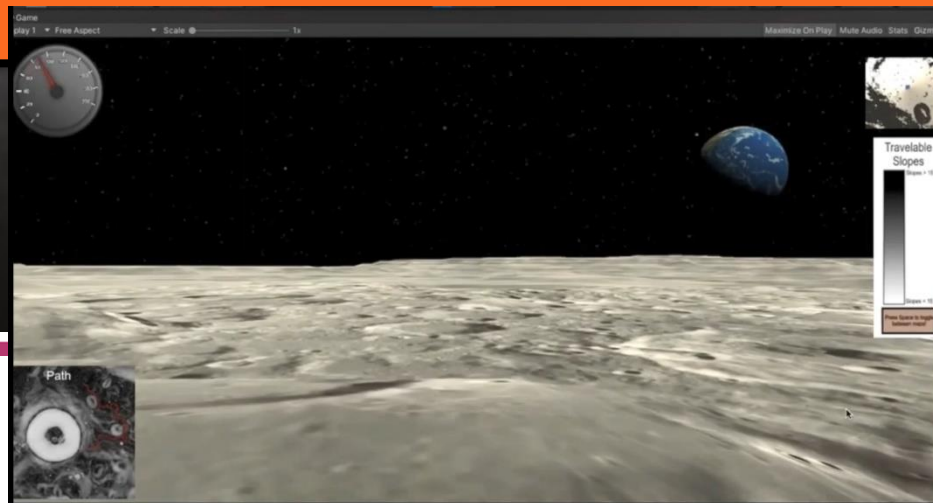


Eligibility



FY20 Eligibility

- Formal or informal U.S. education organizations may participate.
- Teams may be a middle school team or a high school team. Student participants must be on one team only.
 - All members of a middle school team must be in grades 5-8 during the 2020-2021 school year.
 - All members of a high school team must be in grades 9-12 during the 2020-2021 school year.
- Be on a team led by a certified and practicing K-12 educator, i.e. Lead Teacher
 - The minimum team size is 5 students and 1 Lead Teacher. There is no maximum team size. However, Top Teams who are invited to a NASA field center may only send 5 students, the Lead Teacher, and one chaperone.
- The Lead Teacher must complete an Educator Professional Development Collaborative (EPDC) Moon to Mars webinar and submit a certificate of completion.
- Signed letter of support from principal or administrator of your organization must be submitted during registration to confirm participation.



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Requirements



Student teams must:

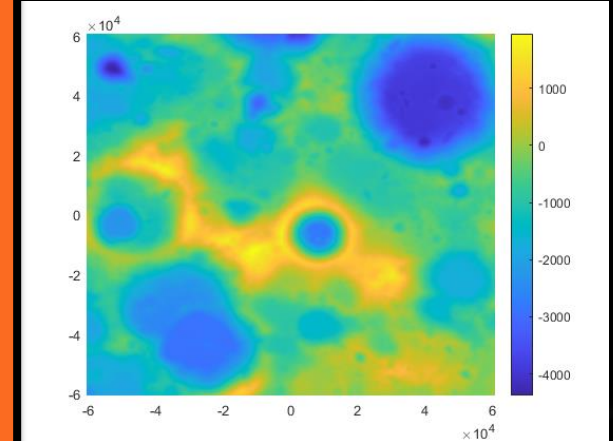
- Use any programming language (e.g. Java, Scratch, etc.) and/or operating systems (Windows, Android, etc.) to complete development of an app.
- Submit a video of original student led work on the completed app.
- Adhere to school districts' or organizations policies regarding participation in the challenge.
- Complete program requirements as identified by the ADC team.

FY20 Middle and High School teams were required to:

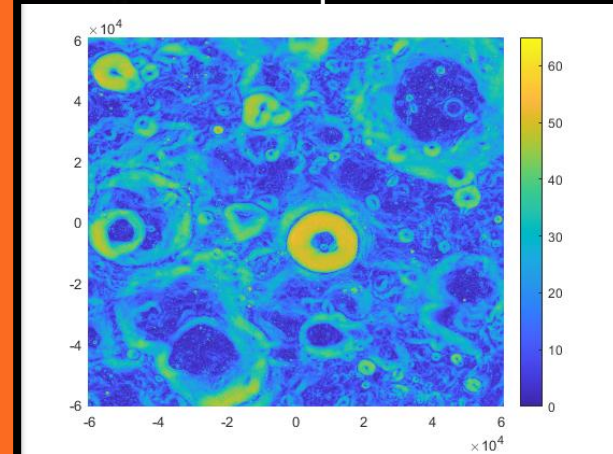
- Be able to process and read all provided position and slope data of the lunar South Pole region.
- Display all position and slope data in some meaningful form beyond text.
- Visualize a path that accounts for mission planning goals and identify communication link checkpoints.
- Calculate and display elevation and azimuth angles. (High School teams only)

ADC teams were supported during the challenge with live virtual connections from NASA subject matter experts.

Height



Slope

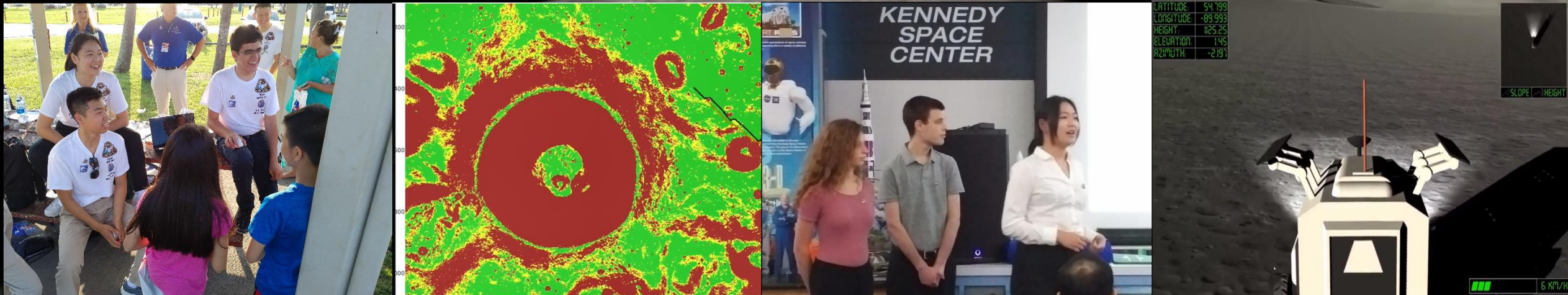




Culminating Event



- Top Teams will be invited to a NASA Field Center for a 2-3 day Culminating Event or attend a virtual event.
- Top Teams will participate in a host of activities while onsite including touring NASA facilities, hearing from subject matter experts, presenting their winning solutions to varying audiences (NASA employees, student peer groups, ADC Collaborators, general public, etc.), engaging in the latest Moon to Mars STEM lessons, and learning about more opportunities from the Office of STEM Engagement.



<https://www.nasa.gov/education/appchallenge>

Email: JSC-M2MSTEM@mail.nasa.gov



Timeline



New FY21 Challenge Coming Soon!

- We are targeting late Spring/Early Summer for the next ADC.
- All information will be available on the ADC website and NASA social media.
- Sign-up for the NASA EXPRESS Newsletter
 - <https://www.nasa.gov/stem/express>

<https://www.nasa.gov/education/appchallenge>

Email: JSC-M2MSTEM@mail.nasa.gov



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Human Exploration Rover Challenge (HERC)



Students design, build, and test human-powered rovers and technologies capable of traversing exoplanetary-like landscapes and completing mission-objective tasks.

Contributions to the Mission:
Provides research and development of new technologies for future mission planning and crewed space missions to other worlds

<https://www.nasa.gov/roverchallenge>



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Overview

- HERC challenges U.S. & International high school and college students represented by two student drivers, at least one female, to traverse the 0.5 mile terrain of simulated asteroid debris, boulders, erosion ruts, crevasses, ancient stream bed, and more while completing various scientific tasks
- Limited by a virtual 8-minute supply of oxygen
- Make real-time decisions to earn points for successfully completing obstacles and mission tasks.
- Two excursions
- The highest number of points within the allotted time (70% of overall score with 2 previous reports rounding out with the 30%)
- The Challenge begins in October and concludes with event at U.S. Space & Rocket Center in April



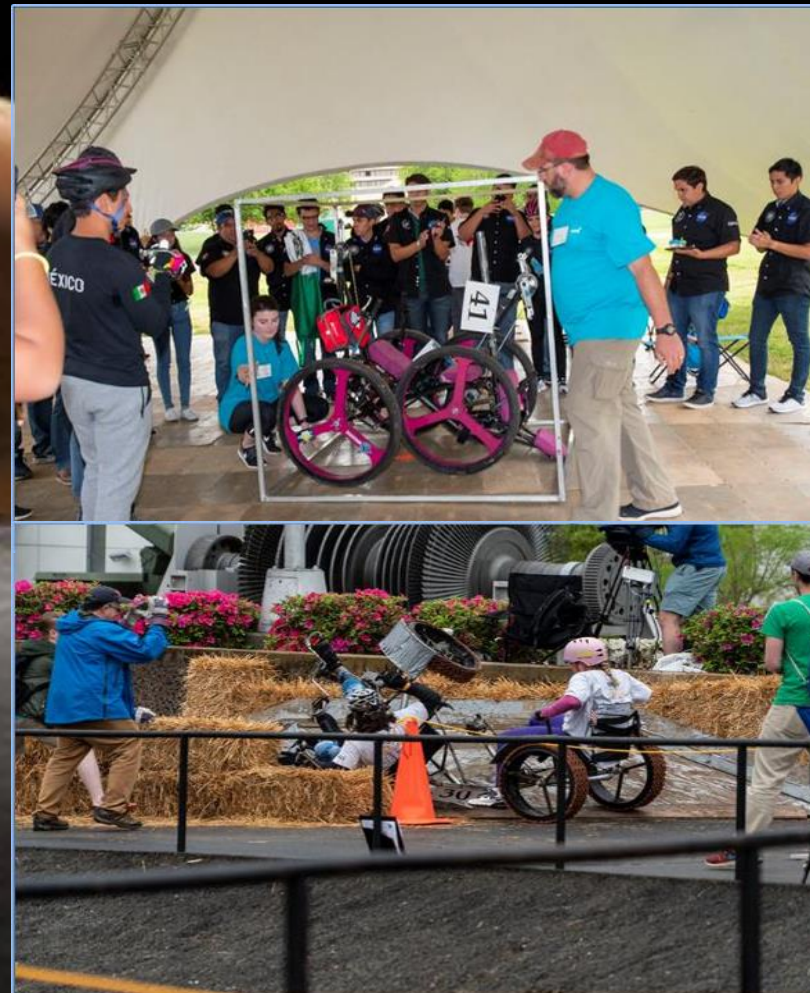
Eligibility

- Registration open to US teams; Proposal process for International teams
- Two teams allowed from US schools and one team from International schools
- Teams should be from schools that are accredited institutions or an institution such as a science center, museum, planetarium, or youth-serving organization
- Teams members must be enrolled in the school they represent
- Each team must identify and be accompanied by an adult age 21 or older to serve as mentor, advisor, and/or education representative
- Teams must be ready to meet deadlines and provided required materials for event



Requirements

- Two reports/reviews: Design Review & Operational Readiness Review (ORR) (30% of overall score)
- Excursion points score (70% of overall score)
- Mission Readiness Review (MRR)
- Safety/Excursion Readiness Review (ERR)
- Students on the team will do 100% of the project, including design, construction of their vehicle and task components (including performing work that is supported by a professional machinist for the purpose of training or safety), written reports, presentations, and competition preparation.
- Complete the requirements checklist with various deadlines
- STEM engagement activities with other schools/organizations with emphasis on middle school students
- Media releases and student data forms
- Social media presence to inform public about team activities and progress



Timeline

Date	Task Name
10/08/2020	Registration opens for US teams; proposals due for Internationals
11/05/2020	Registration closes for US teams
11/06/2020	International teams selected
11/12/2020	Social media presence established for all teams
11/19/2020	Kickoff webinar and Q&A session
1/13-28/2021	Design Review & Presentations
3/10-25/2021	Operational Readiness Review & Presentations
4/15/2021	Competition Day 1 (MRR & Safety)
4/16/2021	Competition Day 2 (Excursion 1)
4/17/2021	Competition Day 3 (Excursion 2 & Awards Ceremony)

Culminating Event

- Two reports/reviews: Design Review & Operational Readiness Review (ORR) (30% of overall score)
- Travel to Huntsville for competition excursion of various obstacles and tasks (70% of overall score)
- Meet with various NASA engineers and scientists as well as peers from around the world
- Talk with leading aerospace companies about potential career pathways
- Experience all the U.S. Space & Rocket Center has to offer as a NASA visitor center



Student Launch (SL)

2020 **SL**
NASA
Student Launch



Students develop rocket propulsion systems and payloads to provide research for the agency.



Contribution to the Mission

- New and unique solutions to current challenges
- Future workforce experienced with NASA's Engineering Design Lifecycle and NASA contracting practices
- Ability to indirectly share STEM topics, lessons, and NASA's message through team STEM Engagement efforts
- Positive media exposure



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What is NASA Student Launch?

NASA Student Launch (SL) is a researched-based, hands-on activity. It provides relevant, cost-effective research and development of rocket propulsion systems. It also provides a real-life STEM experience for students.



- SL provides NASA-unique opportunities through a national STEM challenge. The 2020-2021 NASA Student Launch activity emphasizes the Space Launch System (SLS), Artemis, and future planetary exploration missions.
- The activity reaches middle schools, high schools, informal education institutions, colleges and universities across the nation through an 8-month project to design, construct, and fly high-powered rockets with a scientific payload. The teams will share the research results, which can be used in future design and development of NASA projects.

<https://www.nasa.gov/studentlaunch>

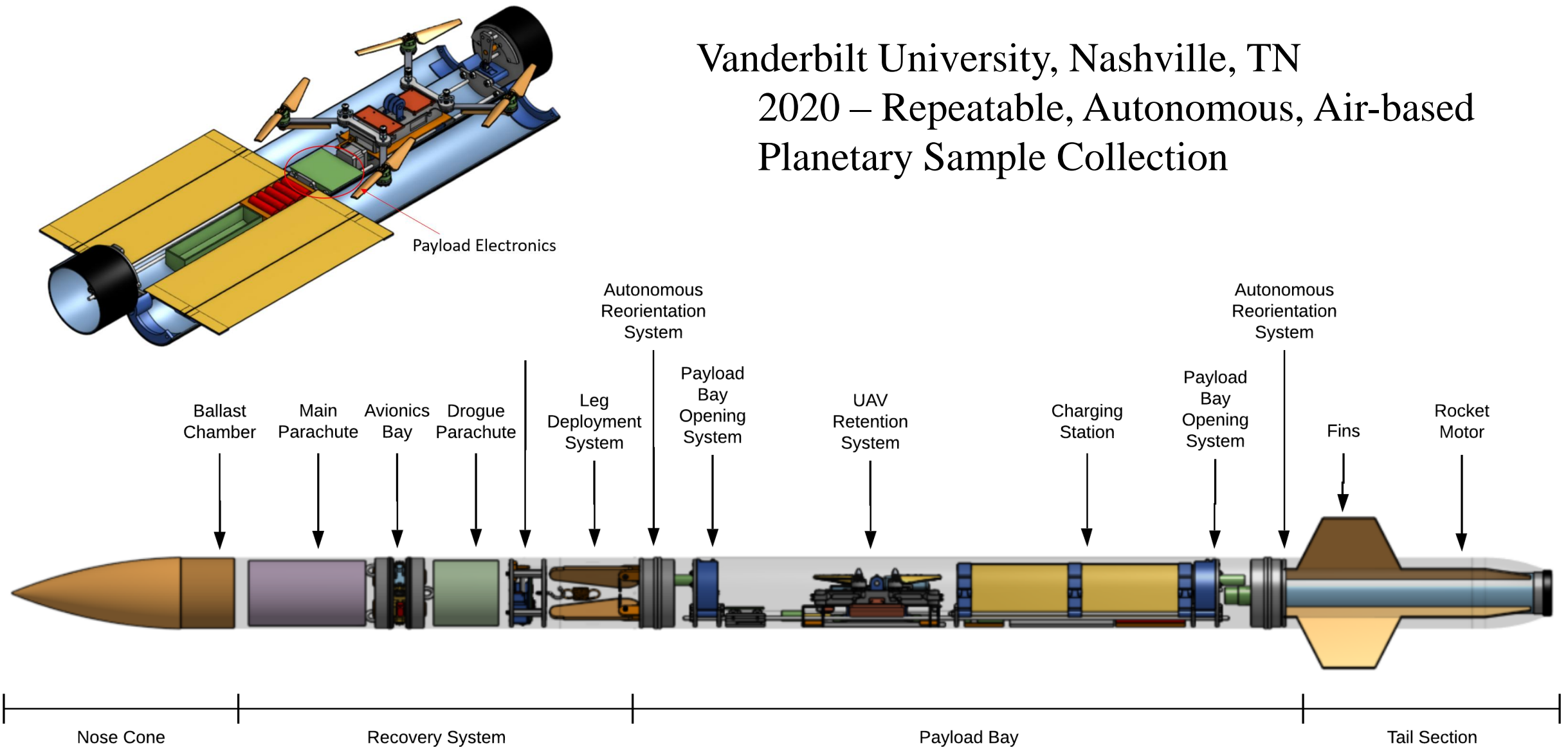
Basic Challenge Requirements

- 8-month commitment (Sept 2020 – May 2021)
- Engineering design challenge; teams must send in a proposal and be competitively selected
- Design and build a reusable rocket to fly to 3,500 to 5,500 feet above ground level carrying a scientific or engineering payload
 - Target altitude declared at PDR milestone (November)
 - Motor choice declared at CDR milestone (January)
- Successfully complete 4 milestone reports, 3 design reviews and a flight hardware and safety inspection
- Work with a qualified local mentor
- Conduct local subscale and full-scale test flights
- Provide STEM engagement activities reaching 200 or more teachers or students
- Develop and maintain a social media presence
- Travel to Huntsville, Alabama for Launch Week or attend virtually

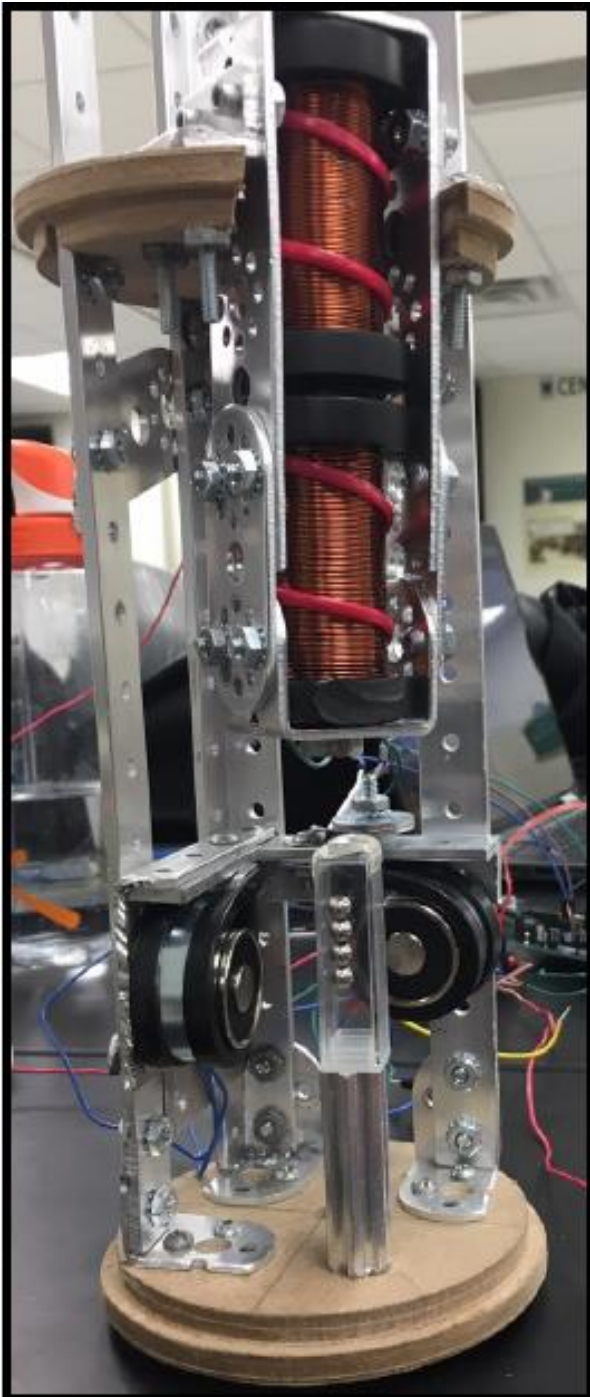
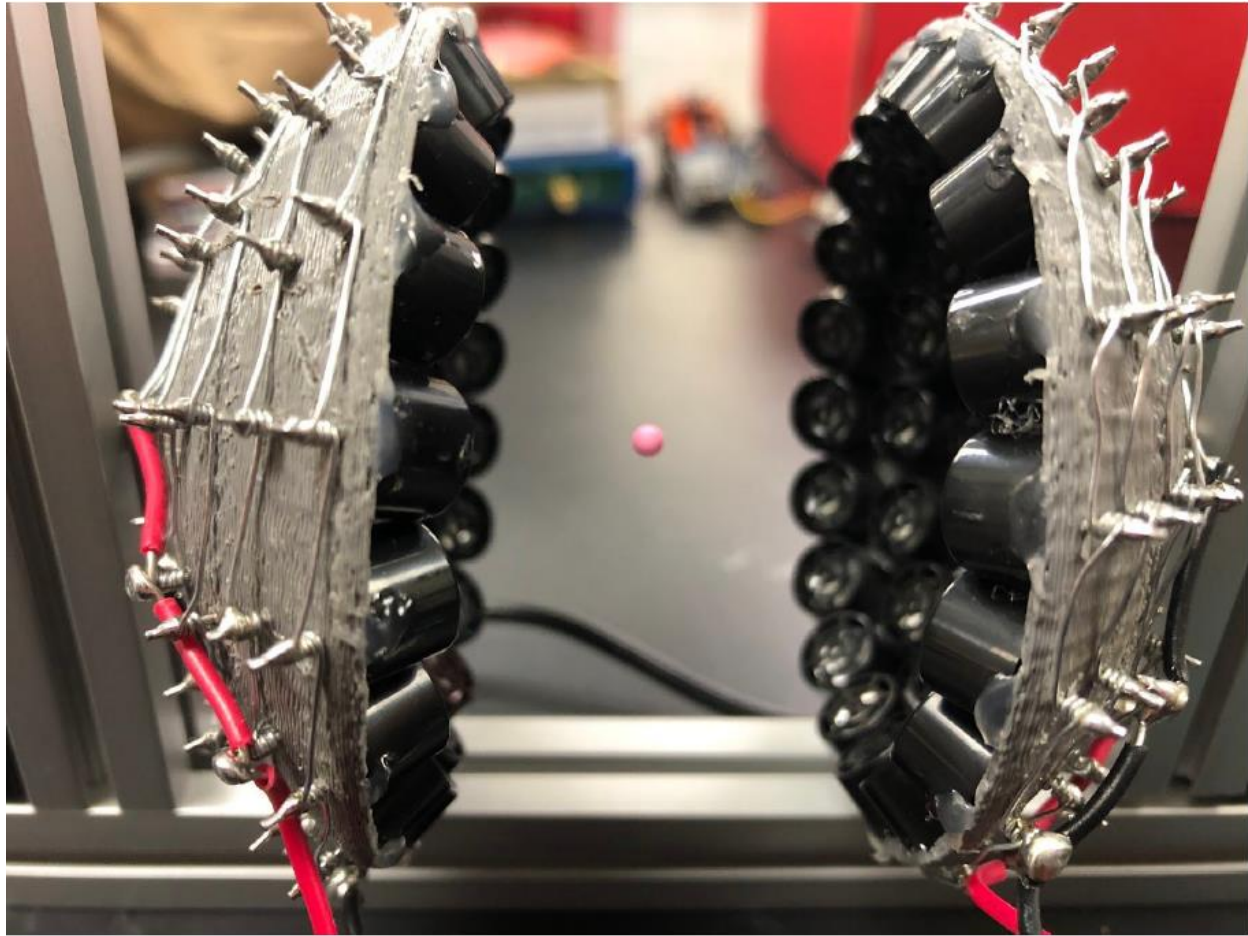


Vanderbilt University, Nashville, TN

2020 – Repeatable, Autonomous, Air-based Planetary Sample Collection



Saint Vincent - Saint Mary's High School, Akron, OH
2019 - Magnetic Levitation
2020 - Acoustic Levitation



Educational Value

Mission-driven authentic STEM experience encompassing:

- Design, construction, and testing of hardware applicable to future NASA missions
- Application of classroom lessons
- Technical writing skills
- Presentation skills
- Budgets / Purchasing
- Timelines & schedules
- Community outreach
- Conducting STEM
- Engagement
- Teamwork
- Stress management



Activity Timeline

<u>August 19, 2020:</u>	Request for Proposal (RFP) distributed
<u>September 21, 2020:</u>	Proposals submission deadline
<u>October 1, 2020:</u>	Proposals awarded / Teams announced
<u>November 2020:</u>	Preliminary Design Review (PDR) / Social Media presence established
<u>January 2021:</u>	Subscale flight due / Critical Design Review (CDR)
<u>March 2021:</u>	Full-scale flight(s) due / Flight Readiness Review (FRR)
<u>April 8-11, 2021:</u>	Launch Week activities (in-person and virtual) - Flight Hardware / Safety Inspection, Tours, Rocket Fair
<u>April 10, 2021:</u>	Launch Day, Awards Banquet
<u>April and May 2021:</u>	Launch window for virtual teams
<u>May 2021:</u>	Post-Launch Assessment Review (PLAR) due / Overall Winner and Top 10 Announced

<https://www.nasa.gov/studentlaunch>

Email: Fred.Kepner@nasa.gov



Eligibility to Propose

High school/middle school division teams must qualify by placing in the top 25 at The American Rocketry Challenge (TARC) or the top 3 of the Rockets For Schools (Class 2) competition. An adult educator, mentor, or administrator is required to attend the summer NASA Advanced Rocketry Workshop. Teams may participate for up to 2 project years without the need to requalify.

Any United States college or university may propose.



TARC - <https://rocketcontest.org/>

R4S - <http://www.rockets4schools.org/>



<https://www.nasa.gov/studentlaunch>

Email: Fred.Kepner@nasa.gov

Perseverance: Mars 2020 STEM Toolkit

- Over 68 activities, challenges and resources.
- Thursday, February 18th, 2021.
- 3:48pm ET. Entry, Descent and Landing, also known as EDL.
- 3:55pm ET. Landing on Mars.

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Connect Students to #CountdownToMars

MARS 2020 STEM TOOLKIT

Join the Mission to Mars Student Challenge

Watch the video [Perseverance Arrives at Mars: Feb. 18, 2021 \(Mission Trailer\)](#)

Design and build a mission to Mars and land it with the Perseverance rover!

Pre-register to join NASA's [Mission to Mars Student Challenge](#) launching in January 2021!

Lead students in designing and building a mission to Mars with a guided education plan and resources from NASA. Join in live stream Q&As with experts and share student work with a worldwide audience. The challenge culminates on February 18, 2021, when students can land their missions along with the Perseverance Mars rover!

https://www.nasa.gov/stem/nextgenstem/moon_to_mars/mars2020stemtoolkit

nasa.gov/joinartemis



Build a Model SLS Rocket
With School Supplies



Build and Test a Spacecraft
and Protect Your
Astronauts



Forward to the Moon With
Artemis Explorer Activities



Color My Space with NASA



Learn How To Draw
Artemis

Decorate Your Space



Space Launch System
Infographics



Artemis Poster



Print Your Artemis
Generation Certificate



Orion Background for
Virtual Classroom



Lunar Background for
Virtual Classroom

Learn About Artemis



How We Are Going to the
Moon



'No Small Steps' Video
Series



What Is Orion?



Orion Quick Facts



Humanity's Return to the
Moon

Teach Artemis

STAY UPDATED!



@NASAArtemis



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@nasaartemis

NASA Express
nasa.gov/stem/express

Conclusion

Questions?

Contact Information:

ADC: JSC-M2MSTEM@mail.nasa.gov

HERC: msfc-roverchallenge@mail.nasa.gov

SL: Fred.Kepner@nasa.gov

Thank you for attending!

