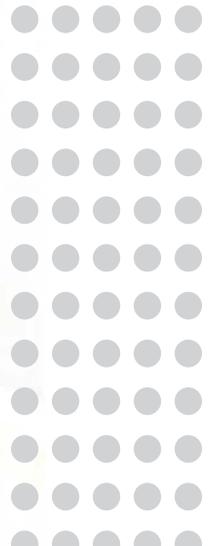




NASA STEM ENGAGEMENT HIGHLIGHTS 2019





At NASA, we are committed to engaging students across our nation to join us on our journey of exploration and discovery. Over the past year, students have worked side by side with NASA engineers, scientists and technologists; participated in experiential learning opportunities; engaged in exhibits and activities in museums and out-of-school programs; and benefited from NASA investments in faculty, teachers and institutions all over the nation. Our portfolio of STEM engagement activities and opportunities designed to attract, engage and educate students, support educators, and educational institutions across the nation is compelling: internships and fellowships, research and development opportunities, challenges and competitions, pre-college and college STEM learning experiences, educator and faculty support, and institutional investments.

We envision NASA's work with students will attract and engage the Artemis Generation – our future aerospace workforce – and stimulate interest in STEM careers. NASA is making valuable contributions to our nation's STEM ecosystem by creating mission-driven opportunities for students to contribute to NASA's work, helping to build a vibrant and diverse next-generation STEM workforce, and leveraging unique opportunities toward enhancing STEM literacy.

You are invited to explore the impact of NASA's STEM engagement efforts in the pages that follow.

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NASA STEM ENGAGEMENT STRATEGY

VISION

We immerse students in NASA's work, enhance STEM literacy and inspire the next generation to explore.

MISSION

We engage students in NASA's mission.

FOCUS AREAS

Create unique opportunities for students to contribute to NASA's work in exploration and discovery.

Build a diverse future STEM workforce by engaging students in authentic learning experiences with NASA's people, content and facilities.

Strengthen understanding of STEM by enabling powerful connections to NASA's mission and work.



NASA's STEM Engagement at a Glance

In FY2019, NASA's congressionally appropriated \$110 million STEM Engagement Program executed a robust and diverse set of projects and activities for the benefit of students at the K-12, undergraduate and graduate levels. These activities ranged from direct student awards for NASA internships and fellowships; student challenges, competitions and other learning activities; faculty and teacher opportunities and resources; awards to educational institutions for research and development; and awards to informal educational institutions to create and deploy student learning opportunities. The STEM Engagement Program is comprised of four projects: the NASA Minority University Research and Education Project (MUREP), National Space Grant College and Fellowship Project (Space Grant), Established Program to Stimulate Competitive Research (EPSCoR) and the Next Generation STEM Project (NextGen STEM).

These four projects capitalize on a unique national network of partners and educational institutions, including colleges and universities; state and local educational institutions; museums, science centers and informal educational organizations; and associations and nonprofit entities, to most effectively magnify reach and impact when serving students.

Through its diverse yet focused set of efforts, NASA's STEM Engagement Program makes compelling contributions to federal STEM education goals toward building a strong foundation for STEM literacy; increasing diversity, equity and inclusion in STEM; and preparing the STEM workforce for the future.

In FY2019, NASA's STEM Engagement community demonstrated evidence of progress, continuing to enhance its capacity to assess the efficacy of STEM Engagement investments

and measure progress in achieving performance goals and annual performance indicators. This included the development and execution of a new Learning Agenda, which serves as the foundation for building a culture of learning and continual improvement. Through this Learning Agenda, an evidence-based decision-making process is employed annually to facilitate the assessment, validation and use of a body of evidence to inform budgetary, policy, programmatic and operational decisions.

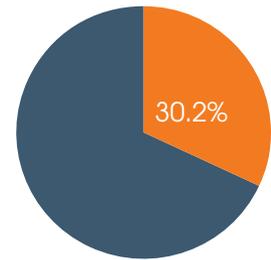
Overall, 2019 yielded powerful work in attracting, engaging and educating students and supporting teachers, faculty and educational institutions nationwide. These efforts are central to building our next-generation workforce, stimulating interest in STEM careers and fostering an understanding of the power and value of STEM.

NASA STEM ENGAGEMENT SUMMARY OF IMPACT

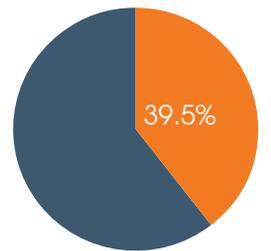
INTERNSHIPS, FELLOWSHIPS and OTHER HIGHER EDUCATION AWARDS

8,005 internships, fellowships and other higher education awards

\$32M direct financial support to higher education students



30.2% of higher education awards were to racially or ethnically underrepresented student participants



39.5% of higher education internships and fellowship positions were filled by women

RESEARCH and DEVELOPMENT

1,374 peer-reviewed publications, technical papers and presentations reported by Space Grant, MUREP, and EPSCoR grantee and awardee institutions



OSTEM collaborated with **1,695** institutions and organizations



Collaborators were funded and unfunded from across all **50** states, plus the District of Columbia, Guam, Puerto Rico and U.S. Virgin Islands



PARTNERSHIPS, STUDENTS and EDUCATORS

Competitive grants and cooperative agreements awarded to

95

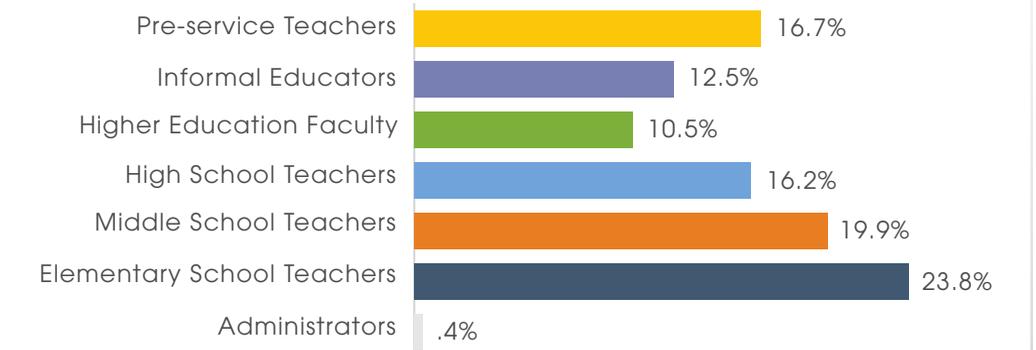
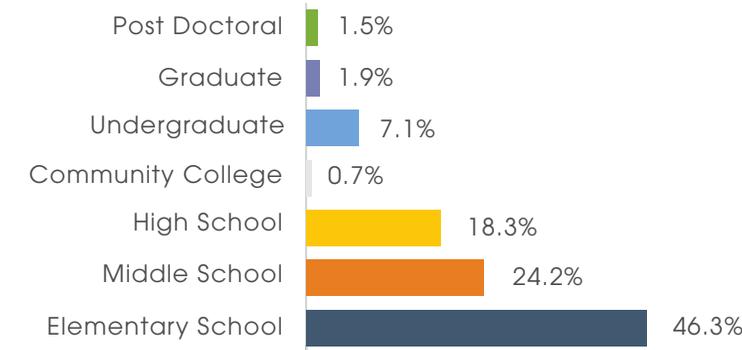
educational institutions located in all

50

states, plus the District of Columbia, Guam, Puerto Rico, and U.S. Virgin Islands

827,257 students participated in NASA STEM engagement*

182,601 educators participated in NASA STEM engagement training activities*



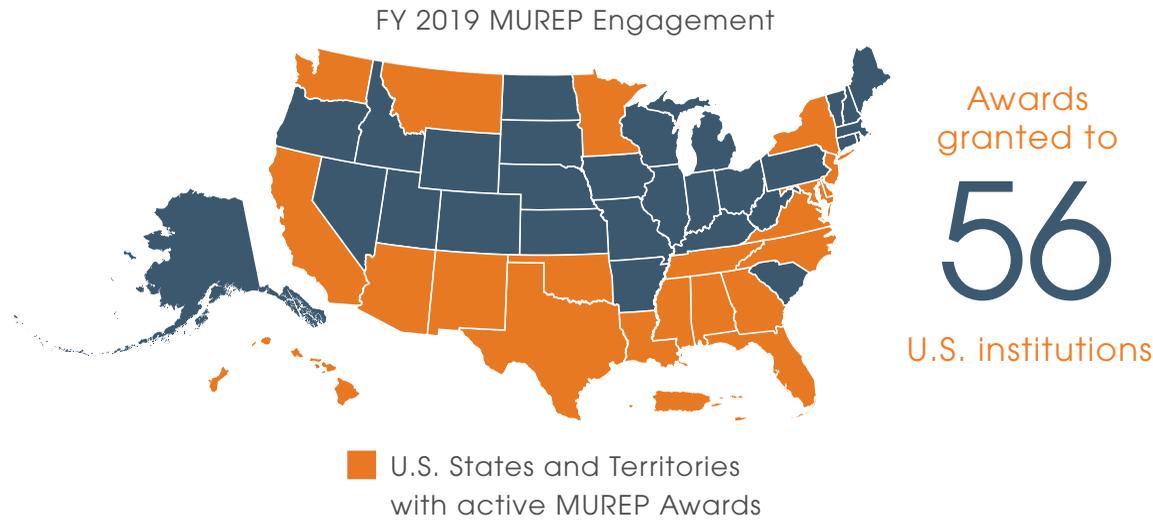
* Participation numbers are self-reported by external grantees, awardees and collaborators

* Summary of impact for FY2018 based upon validated body of evidence collected for the entire fiscal year.

NASA STEM ENGAGEMENT PROGRAM SNAPSHOT

MUREP (\$33M)

The NASA Minority University Research and Education Project (MUREP), provides financial assistance via competitive awards to Minority-Serving Institutions, or MSIs. These opportunities are available to Historically Black Colleges and Universities, Hispanic-Serving Institutions, Asian-American and Native American Pacific Islander-Serving Institutions, Alaska Native and Native Hawaiian-Serving Institutions, American Indian Tribal Colleges and Universities, Native American-Serving Nontribal Institutions and other MSIs as required by MSI-focused Executive Orders. In turn, these schools actively recruit and retain underrepresented and underserved students, including women and persons with disabilities, into STEM fields. For more information, visit nasa.gov/stem/murep



NASA's Jet Propulsion Laboratory hosted 50 pre-service teachers for a week-long professional development workshop as part of NASA's MUREP Educator Institute. Image Credit: NASA

SPACE GRANT (\$44M)

The National Space Grant College and Fellowship Project, or Space Grant, is a national network of colleges and universities. This network of consortia in every state, the District of Columbia and Puerto Rico, as well as their affiliates from universities, colleges, industry, museums, science centers, and state and local agencies, conducts a spectrum of initiatives and programs to enhance STEM education. Initiatives include student fellowships and internships, faculty development and curriculum enhancement, and pre-college and public service education efforts. For more information, visit nasa.gov/stem/spacegrant

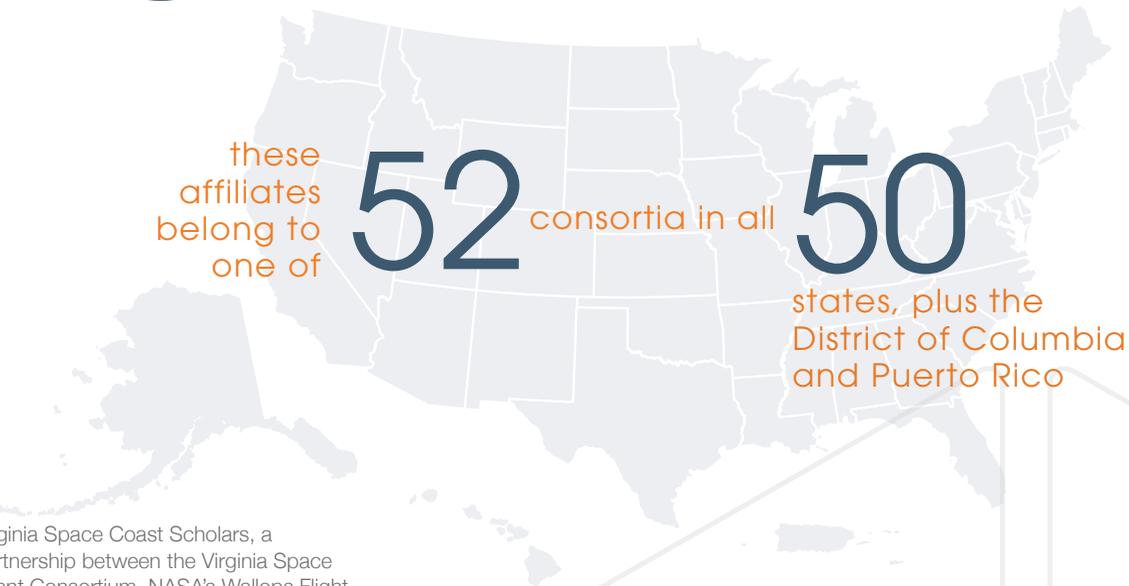


Virginia Space Coast Scholars, a partnership between the Virginia Space Grant Consortium, NASA's Wallops Flight Facility and the Mid-Atlantic Regional Spaceport, built model rockets as part of the Virginia Space Coast Scholars Summer Academy at Wallops. Image Credit: Courtesy of Mary Sandy, Virginia Space Grant Consortium.



850

affiliates from universities, colleges, industry, museums, science centers, and state and local agencies.



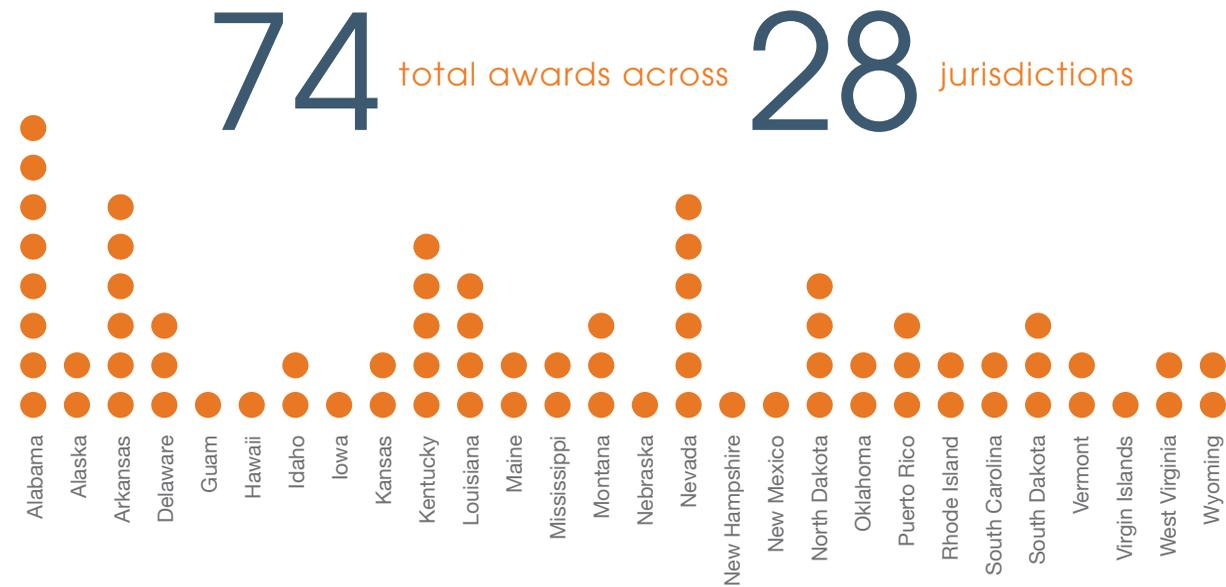
NASA STEM ENGAGEMENT PROGRAM SNAPSHOT

EPSCoR (\$21M)

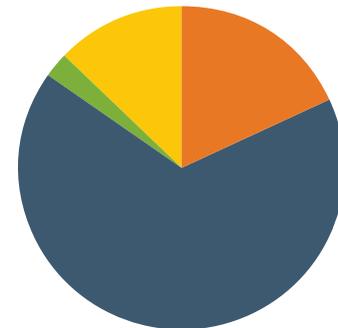
The Established Program to Stimulate Competitive Research, or EPSCoR, establishes partnerships with government, higher education and industry designed to affect lasting improvements in a state or region's research infrastructure, research and development (R&D) capacity and, hence, bolster its national R&D competitiveness. EPSCoR is directed at jurisdictions that have not, in the past, participated equably in aerospace-related research activities. The goal of EPSCoR is to provide seed funding that will enable jurisdictions to develop an academic research enterprise directed toward long-term, self-sustaining and nationally-competitive capabilities in aerospace and related research. For more information, visit nasa.gov/stem/epscor



University of Arkansas Graduate student researchers work in a lab for GeSn film deposition.



EPSCoR Competitive Opportunities



- Research Infrastructure Development
- Research
- International Space Station Flight Opportunity
- Rapid Response Research (R3)

NextGen STEM (\$12M)

The NextGen STEM project invests in a diverse set of efforts and student learning opportunities, including those serving students in K-12. NextGen STEM provides a platform to attract and engage students, as well as enable them to contribute to NASA's endeavors in exploration and discovery. NextGen STEM's mission-driven activities include more than 20 evidence-based products and opportunities in authentic STEM experiences. These opportunities enhance STEM literacy and help build a vibrant and diverse next-generation STEM workforce.

NextGen STEM offers competitive opportunities to museums, science centers, planetariums, NASA Visitor Centers, youth-serving organizations, libraries, and other eligible nonprofit institutions through NASA Teams Engaging Affiliated Museums and Informal Institutions (TEAM II).

In addition, NextGen STEM operates NASA's Museum Alliance, bringing current NASA science and technology to students through professional development of informal education providers and access to NASA staff and materials. The Museum Alliance enables NASA to broadly disseminate valuable learning opportunities to students all over the globe. For more information, visit nasa.gov/stem/nextgenstem

10 astronauts provided In-flight educational opportunities for students



Joe Acaba



Ricky Arnold



Serena Auñón-Chancellor



Randy Bresnik



Drew Feustel



Alex Gerst (ESA)



Norishige Kanai (JAXA)



Paolo Nespoli (ESA)



Scott Tingle



Mark Vande Hei

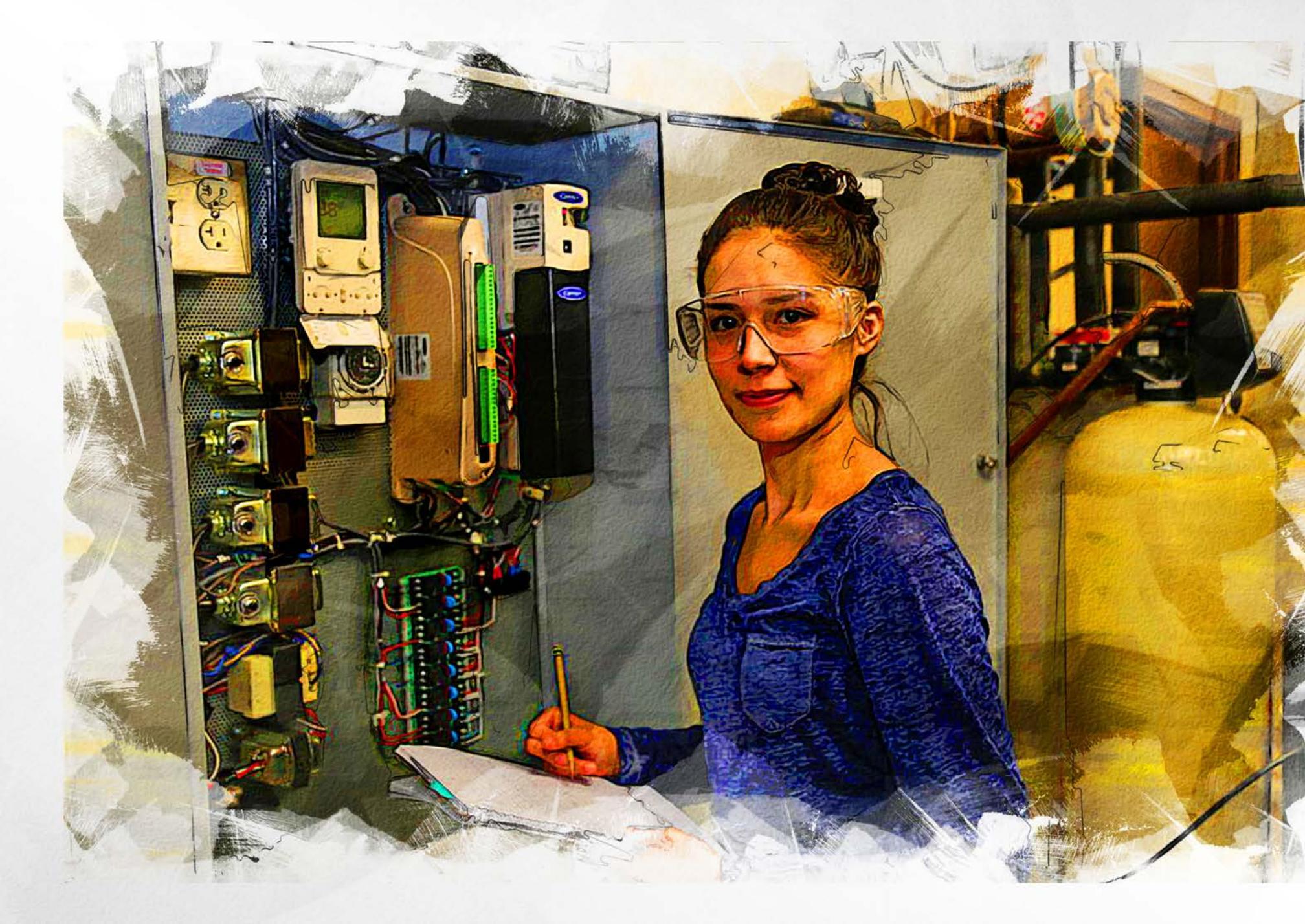
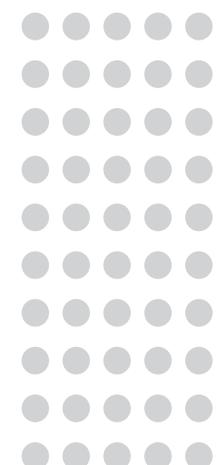
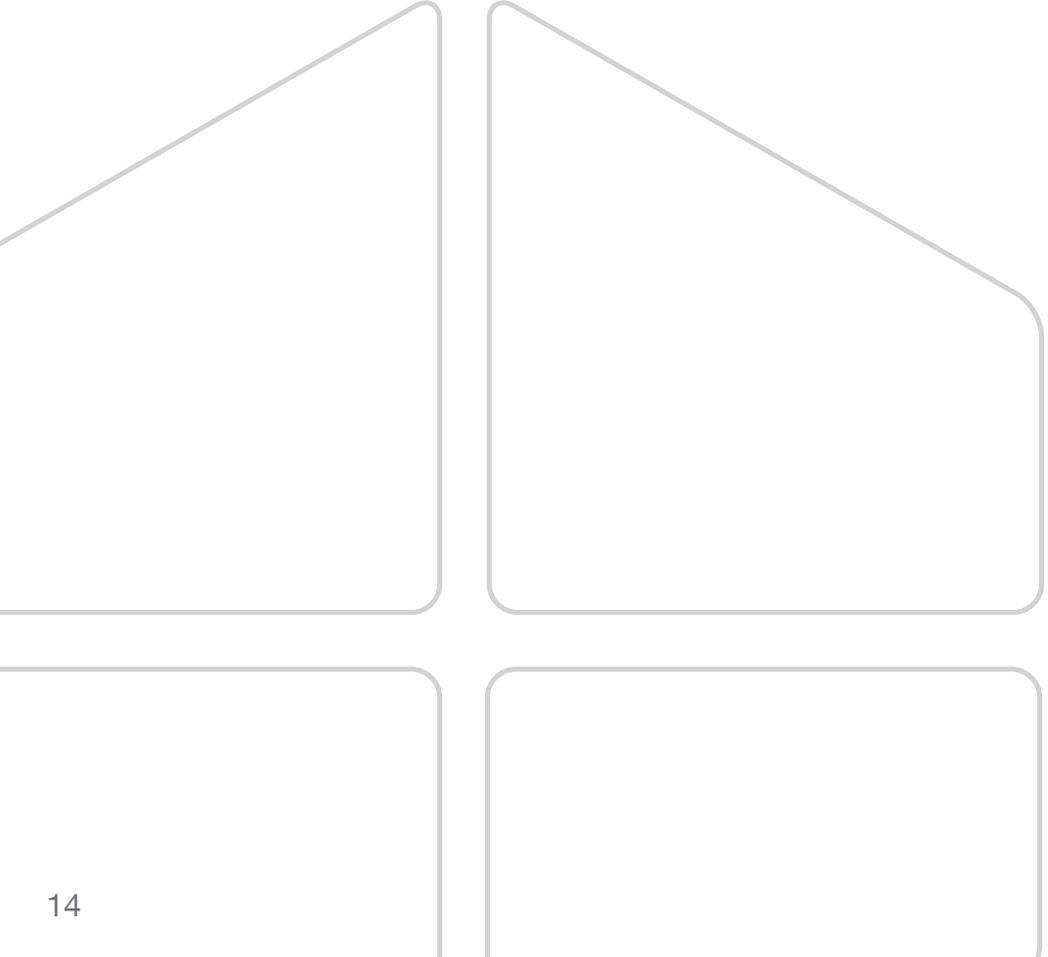
NASA Teams Engaging Affiliated Museums and Informal Institutions (TEAM II)

65+ organizations across 34 states, plus the District of Columbia

NASA's Museum Alliance

1,270 organizations across 39 countries, including the U.S.

STUDENT WORK EXPERIENCES

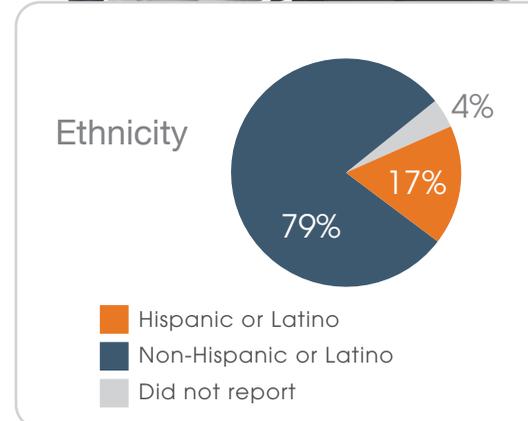
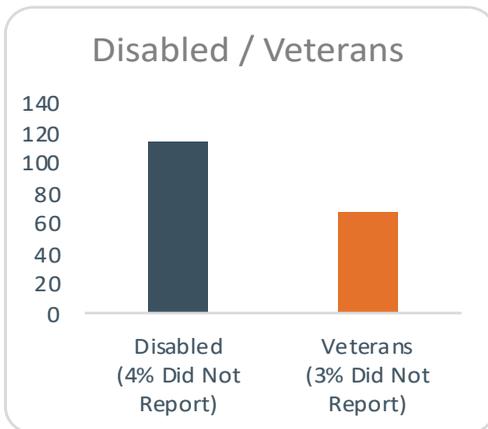
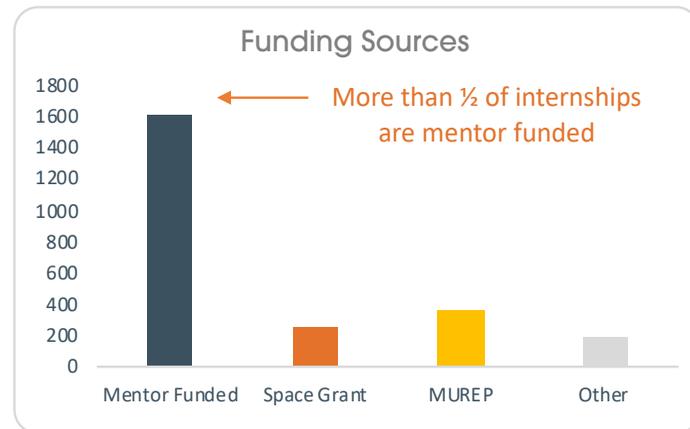
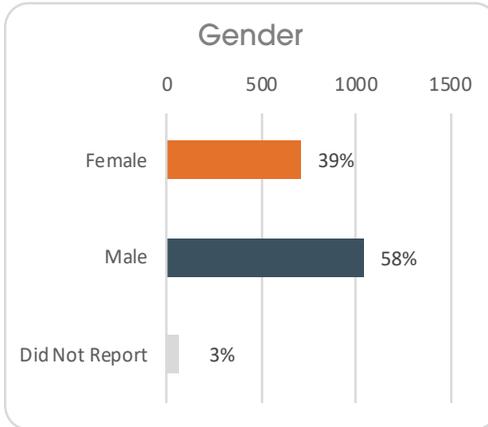
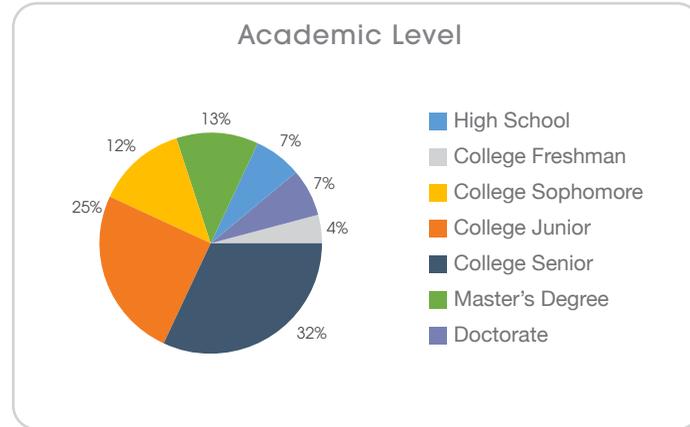


INTERNSHIPS

NASA internships offer unique experiences for high school, undergraduate and graduate students, as well as educators, to integrate with career professionals. Interns are assigned to projects that emphasize degree-related tasks and contribute to the advancement of NASA's missions.

Internships are offered during three sessions throughout the year. Summer internships are 10 weeks in length, and fall and spring internships are 16 weeks. NASA's Office of STEM Engagement interns are funded through a stipend that is competitive with industry standards for internships. Additionally, volunteer internships can be found on intern.nasa.gov. Internship offers are typically extended three months prior to the session start date. However, mentors can select and extend an offer as early as two sessions prior to the start date.

2,031 total interns
1,811 single session
220 multi-session



New mobile app launched in 2019

Interns represent all 50 states plus the District of Columbia, Puerto Rico and U.S. Virgin Islands



FELLOWSHIPS

NASA fellowships are competitive awards that support independently conceived or designed research by highly qualified faculty, undergraduate and graduate students. Fellowships afford students opportunities to directly contribute to NASA's mission efforts and gain valuable learning experiences in STEM disciplines. Fellowship opportunities are focused on innovation and generating measurable research results that help advance NASA's current and future science and technology goals.

31 total NASA fellows, scholars & alumni



NASA successfully awarded renewals to 19 fellows

14 student fellowships awarded to minority-serving institutions through MUREP

5 student fellowships awarded to institutions through the Aeronautics Research Mission Directorate

totaling **\$2.3M** to support graduate student research

SPOTLIGHT ON NASA INTERNS & FELLOWS



Danyale Berry

Marshall Space Flight Center Intern

Danyale Berry, an exercise science major at Winston-Salem State University in North Carolina, is currently working on comparing and contrasting the ground-reaction forces and gait cycles of various neuropathic individuals to support human health, life support and habitation systems to live and work in space by focusing on motion-capture technology via Marshall's Virtual Environments Laboratory.



Emma Dahl

NASA Fellow at New Mexico State

Emma Dahl was invited to participate in the American Astronomical Society Division for Planetary Sciences Conference in Switzerland to present her research work on "Exploring Mechanisms for Change in Jupiter's Atmospheric Structure During the Juno Era." Dahl's research is in measuring the cloud layer in Jupiter's atmosphere.



Alexander Johnson

NASA Fellow at Florida International University

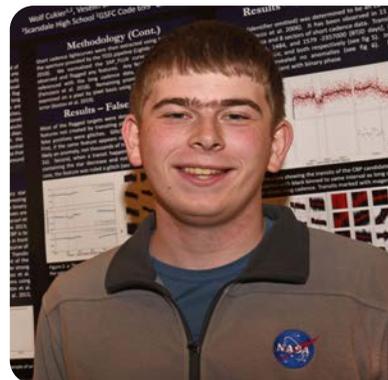
Alexander Johnson was invited to participate in the National Radio Science Meeting sponsored by the U.S. National Committee for the International Union of Radio Science. Johnson presented a paper titled "A Wideband Differentially Fed Tightly Coupled Dipole Array," placing in the top 5 among the complete paper entries.



Andrew Chen

Langley Research Center Intern

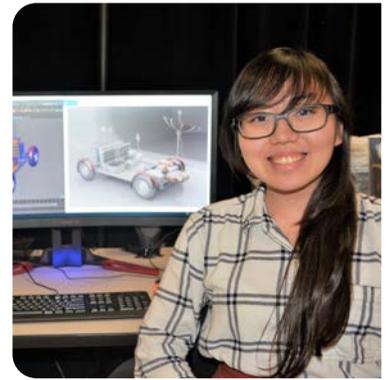
As a recent high school graduate, Andrew Chen was invited to work as a machinist fabrication intern. Chen's internship involved skills like additive manufacturing and metal milling. One of his current projects is helping develop a solar-sailing satellite. Prior to his internship, he also participated in the NASA App Development Challenge.



Wolf Cukier

Goddard Space Flight Center Intern

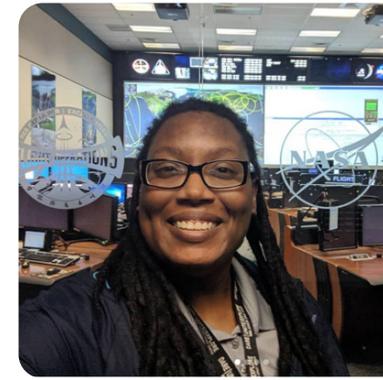
In 2019, Wolf Cukier was a high school summer intern. His job was to examine variations in star brightness captured by NASA's Transiting Exoplanet Survey Satellite (TESS). During his internship, Cukier discovered what is now called TOI 1338 b, TESS' first circumbinary planet. A paper, which Cukier co-authored, has been submitted to a scientific journal.



Sara Horoiwa

Glenn Research Center Intern

Sara Horoiwa is a SCan Project intern at NASA's Glenn Research Center in Ohio, where she supports the Space Communications and Navigations Office and Graphics and Visualization Laboratory. Currently, she is working on a lunar rover 3D model that will be used to help create a virtual-reality simulation, letting users drive the rover on the Moon's surface.



Atalanda Cameron

Johnson Space Center Intern

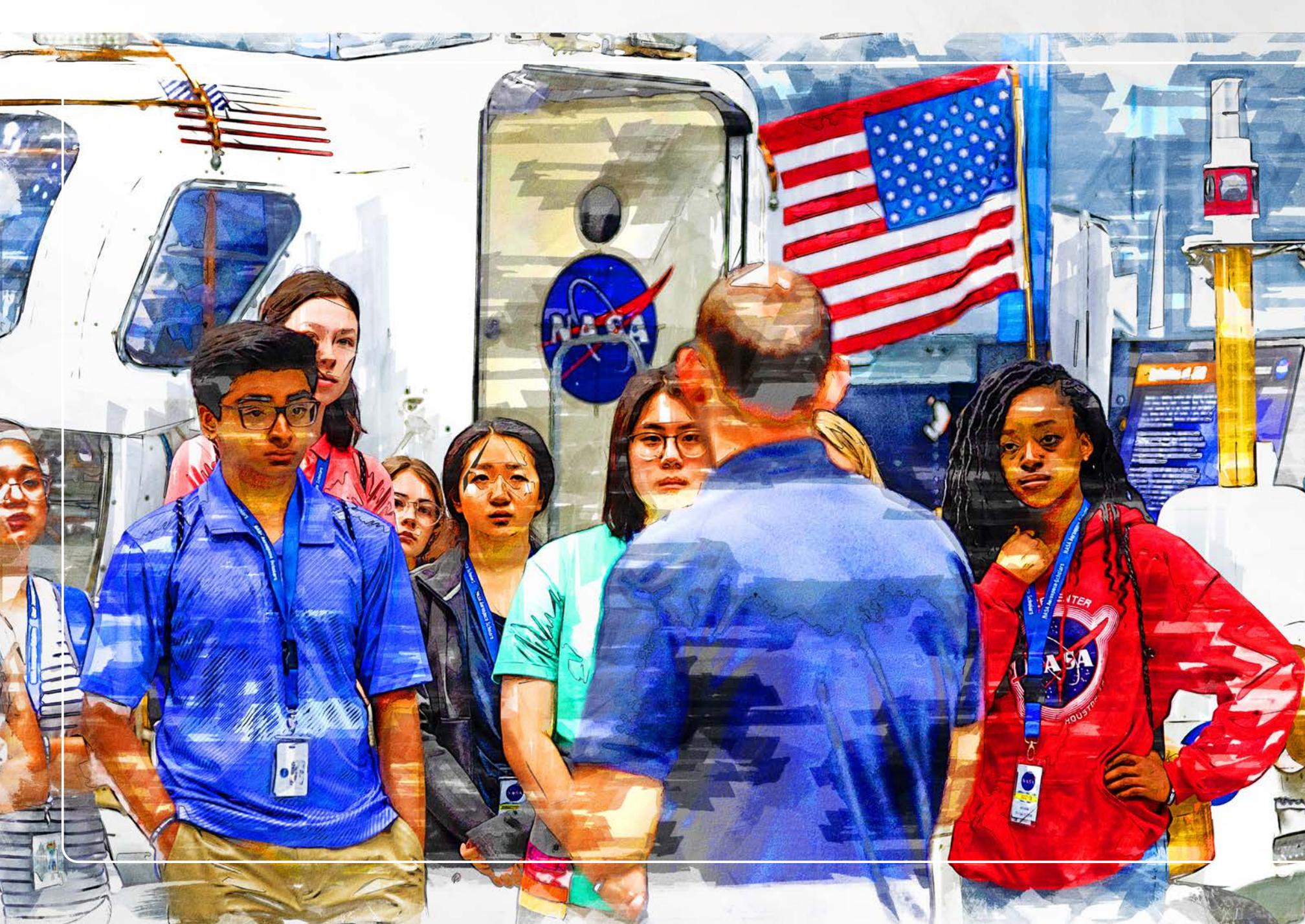
Atalanda Cameron is a senior at the University of Houston-Clear Lake (UHCL), studying environmental biology. She has completed three internships at Johnson Space Center and is currently working with UHCL and NASA as a wildlife survey student researcher, where her efforts will help the agency create a more sustainable future.



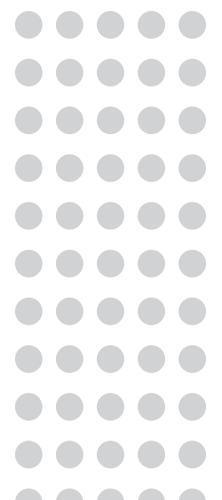
Supreet Kaur

Ames Research Center Intern

Supreet Kaur is a current student at San Jose State University who will earn a Bachelor of Science in industrial and systems engineering. Supreet was a member of the Brooke Owens Fellowship Class of 2019. This summer, she will be working at the Center for Strategic and International Studies as a research intern in the Aerospace Security Project.



STUDENT LEARNING OPPORTUNITIES

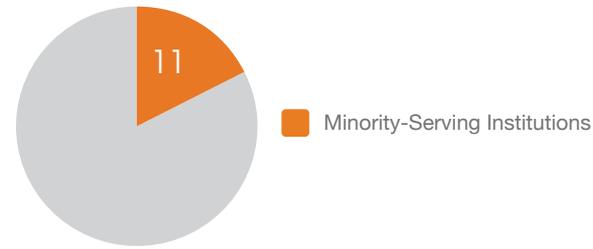


Robotic Mining Competition

More than 300 undergraduate and graduate students from 45 colleges and universities throughout the United States competed in NASA's 2019 Virtual Robotic Mining Competition while NASA constructed a new mining arena. Participating teams submitted a systems engineering paper, reported on their STEM outreach in their communities and provided a virtual slide presentation and robot demonstration.

51 teams registered

across **33** states



In 2020, the Robotic Mining Competition will now be known as NASA's Lunabotics Competition. The name change reflects the future evolution of the competition beyond mining. The competition will be held at NASA's Kennedy Space Center and will use the new mining arena located in the Astronaut Memorial Foundations' Center for Space Education.



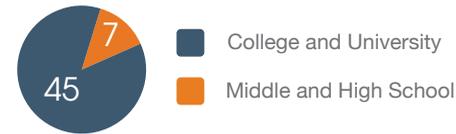
STEM Student Challenges

Student Launch

On April 6, 2019, NASA held Student Launch, a research-based experiential exploration activity that challenges teams comprised of middle, high school, college and university students across the nation to design, build and launch payloads, or vehicle components, that support NASA's Space Launch System. Fifty-two teams participated in the project, with 38 teams ultimately launching their rockets. As part of the challenge requirements, participating teams conducted 269 STEM Engagement events reaching 50,133 participants.

52 teams participated

resulting in **38** successful launches



269 STEM Engagement events



with teams from **21** states



STEM Student Challenges

Human Exploration Rover Challenge

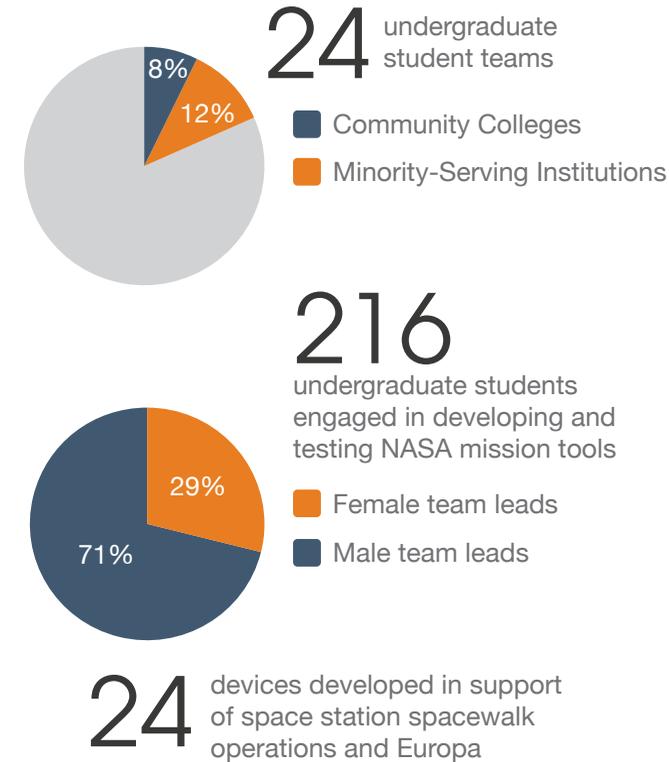
From April 12-13, 2019, NASA held the 25th Annual Human Exploration Rover Challenge which requires teams to design, build and test technologies that enable rovers to perform in a variety of exoplanetary-like landscapes. The competition course requires two students, one female and one male, to traverse a half mile of terrain including obstacles and tasks. Ninety-six teams took part in the competition, hailing from 23 states, the District of Columbia and Puerto Rico, as well as a record number of countries, including Bangladesh, Bolivia, Brazil, the Dominican Republic, Egypt, Ethiopia, Germany, India, Mexico, Morocco and Peru.



STEM Student Challenges

Micro-g NExT

Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) challenged undergraduate students to design, build and test a tool or device to address an authentic, current space exploration challenge. The overall experience included hands-on engineering design and test operations conducted in the simulated microgravity environment of NASA Johnson Space Center's Neutral Buoyancy Laboratory.



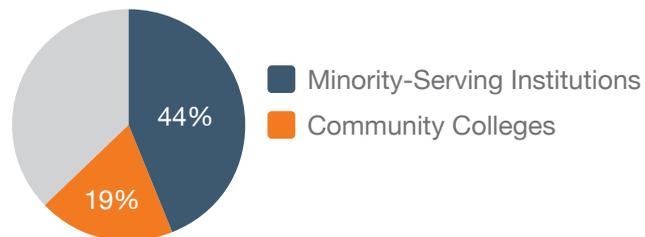
STEM Student Challenges

SUITS

NASA Spacesuit User Interface Technologies for Students (SUITS) gives students an authentic engineering design experience supporting NASA's Artemis mission. This activity challenges students to design and create spacesuit information displays within augmented reality environments. After development, student teams travel to NASA's Johnson Space Center in Houston to test their software designs with unique NASA assets.

200+ higher-education students and faculty engaged

16 higher education institutions from across 12 states



13 teams, 12 on-site, 1 virtual

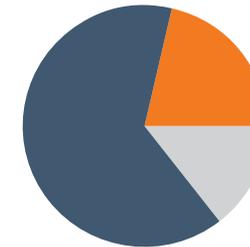


STEM Student Challenges

First Nations Launch

The First Nations Launch Competition provides Native American undergraduate students the opportunity to build and launch Class K high-powered rockets. Participants experience a preliminary design review, critical design review and safety package, and give formal presentations. Students are either members of the American Indian Science and Engineering Society or attend a tribal college.

15 teams, each representing their own school



■ Tribal College or University

■ Alaska Native-Serving and Native Hawaiian-Serving Institutions

■ Native American-Serving Nontribal Institutions Program

101 total student applications



STEM Student Challenges

NASA Community College Aerospace Scholars (NCAS)

NASA Community College Aerospace Scholars (NCAS) is an agencywide STEM engagement activity for community college students to engage in authentic learning experiences with NASA's diverse people, content and facilities. Funded by the Minority Undergraduate Research and Education Project's (MUREP) competitive awards, NASA provides financial assistance to minority serving institutions. These institutions recruit and retain underrepresented and underserved students, including women, girls, veterans and persons with disabilities, into STEM fields.

During the program, students compete to become a NASA Community College Aerospace Scholar by completing STEM-based activities online to become eligible to visit a NASA Center for a four-day, expenses paid, onsite experience.

19 on-site experiences
at
10 NASA centers



NCAS alumni flew research, the MicroAlgae Biosynthesis in Microgravity investigation, on the International Space Station in May 2019, with NCAS continuing the active outreach component.



NCAS piloted a Moon-to-Mars themed robotics competition, Lunar Base Camp, at the 2019 American Indian Higher Education Council's Spring Student Conference.

Student Learning Opportunities

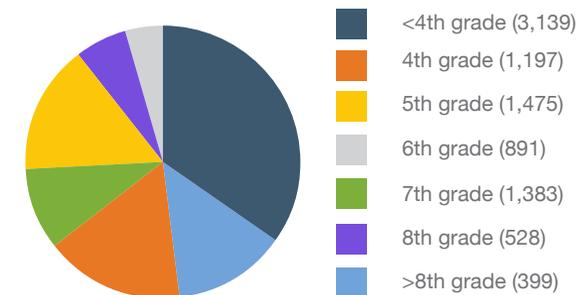
ASTRO CAMP

NASA ASTRO CAMP 2019 day-camp programs provided hands-on, exciting activities centered on exploration and discovery as campers prepared to become the "Next Generation Exploring ...Moon Today & Mars Tomorrow." Students also interacted with NASA professionals, and participated in NASA STEM-themed celebrations known as "NASA Days." These camp-specific events that gave youth and families opportunities to personally interact with NASA in showcasing their camp program success.

NASA ASTRO CAMP 2019 programs were integrated with evidence-based out of school learning/teaching strategies following the ASTRO CAMP proven methodology of collaboration that aligns with current NASA Science Mission Directives.

101 community collaboration programs
255 camp weeks
9,187 campers

2019 ASTRO CAMP Attendance by Grade

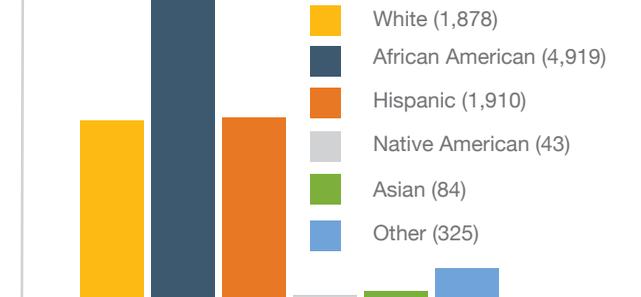


Student Learning Opportunities



Students participate in a hands-on activity at an ASTRO CAMP day-camp program.

2019 ASTRO CAMP Student Ethnicity



NextGen STEM App Development Challenge

NASA's App Development Challenge asked middle and high school teams to design an application to visualize three minutes of simulated test data in support of the Ascent Abort-2 (AA-2) flight test successfully completed July 2, 2019. The AA-2 flight test is a critical step in demonstrating Orion's safety as NASA leads the next steps of human exploration into deep space.



723 student participants
125 educators
13 states
22 schools
28 teams

Student Learning Opportunities

“It was even better than we expected ... it was really useful to be able to see what you could do to get into NASA, how you could approach it (and) where you could work within the organization.”

—Javier Coindreau
 Team Millburn captain



Students who submitted winning NASA App Development Challenge videos were invited to NASA's Kennedy Space Center for the Orion Ascent Abort-2 flight test on July 2, 2019.

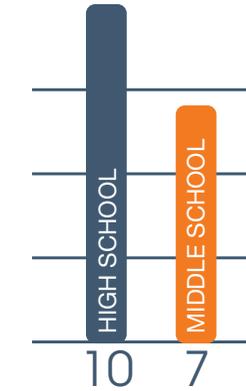
NextGen STEM WEAR Challenge

Wearable Equipment for Averting Radiation (WEAR) kicked off with the challenge for middle- and high-school aged teams to develop garment designs meant to protect astronauts from excessive radiation in deep space. The NextGen STEM Moon to Mars team collaborated with NASA's RadWorks Project and Langley Research Center's Office of STEM Engagement to develop and present the WEAR challenge.

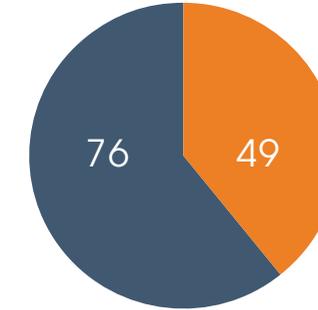


Student winners of the “Wearable Equipment for Averting Radiation” (WEAR) challenge got a tour NASA Langley.

17
 schools submitted proposals



High School Students
 Middle School Students



12 jurisdictions, including Puerto Rico

5 & 5

high school middle school
 teams were selected to participate in the 2019 Wearable Equipment for Averting Radiation Challenge event at NASA's Langley Research Center

Student Learning Opportunities



Student teams develop their own garment designs to protect deep space astronauts from excessive radiation.

“This is showing them what the real application of the work they're doing is — this is not a fictitious or fabricated scenario. I'm hoping this is going to continue to fuel their passion for what they're doing.”

— Adam Middleton
 high school educator

STEM on Station

STEM on Station uses the International Space Station (ISS), its crew and onboard research to advance NASA and the nation's STEM education and workforce pipeline. Using NASA-unique resources and opportunities such as live conversations with astronauts in space, hands-on STEM activities developed through high-profile partnerships and videos filmed by astronauts in space showcasing STEM concepts, STEM on Station inspires, engages and educates students and teachers.

The STEMonstration video library has over **235,000** views

Presented at the STEM Leadership Alliance Summit in Orlando, Florida to

200+ influential STEM leaders

Shared the Google Expeditions ISS tour and information about STEM on Station with

10,000

visitors to the National Mall during the Apollo 11 50th Anniversary Festival

Facilitated

20

downlinks in

14

states plus the District of Columbia reaching

4K

educators and

85K

students



Student Learning Opportunities



Photos from a variety of STEMonstrations videos and STEM on Station downlink events engaging students across the U.S..

STEM on Station Partners with Microsoft to Release New Lesson Series

At the International Society for Technology Education's 2019 National Conference on June 24, the educational partners unveiled eight hands-on lesson plans to engage middle and high school students.



NextGen STEM Commercial Crew Program

The Next Generation STEM Commercial Crew Program (NGS CCP) developed K-12 curriculum and teacher guides, hands-on activities and educator resources, with an emphasis on technology in the classroom.

These resources center on NASA commercial partners and their efforts toward human spaceflight to the space station.

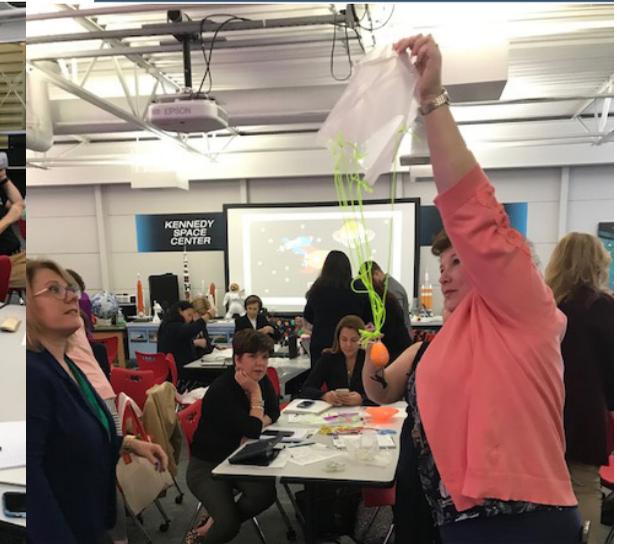
The 360 virtual-reality (VR) tours use personal VR systems, providing educators and students a virtual classroom field trip experience.

The Rocket Science: Ride to Station app takes students through the process of selecting a mission, the rocket and the astronaut crew needed to conduct that mission.

Middle and high school resources also include the Crew Orbital Docking Simulation and an Eggstronaut Parachute Design Challenge using a tracker app.

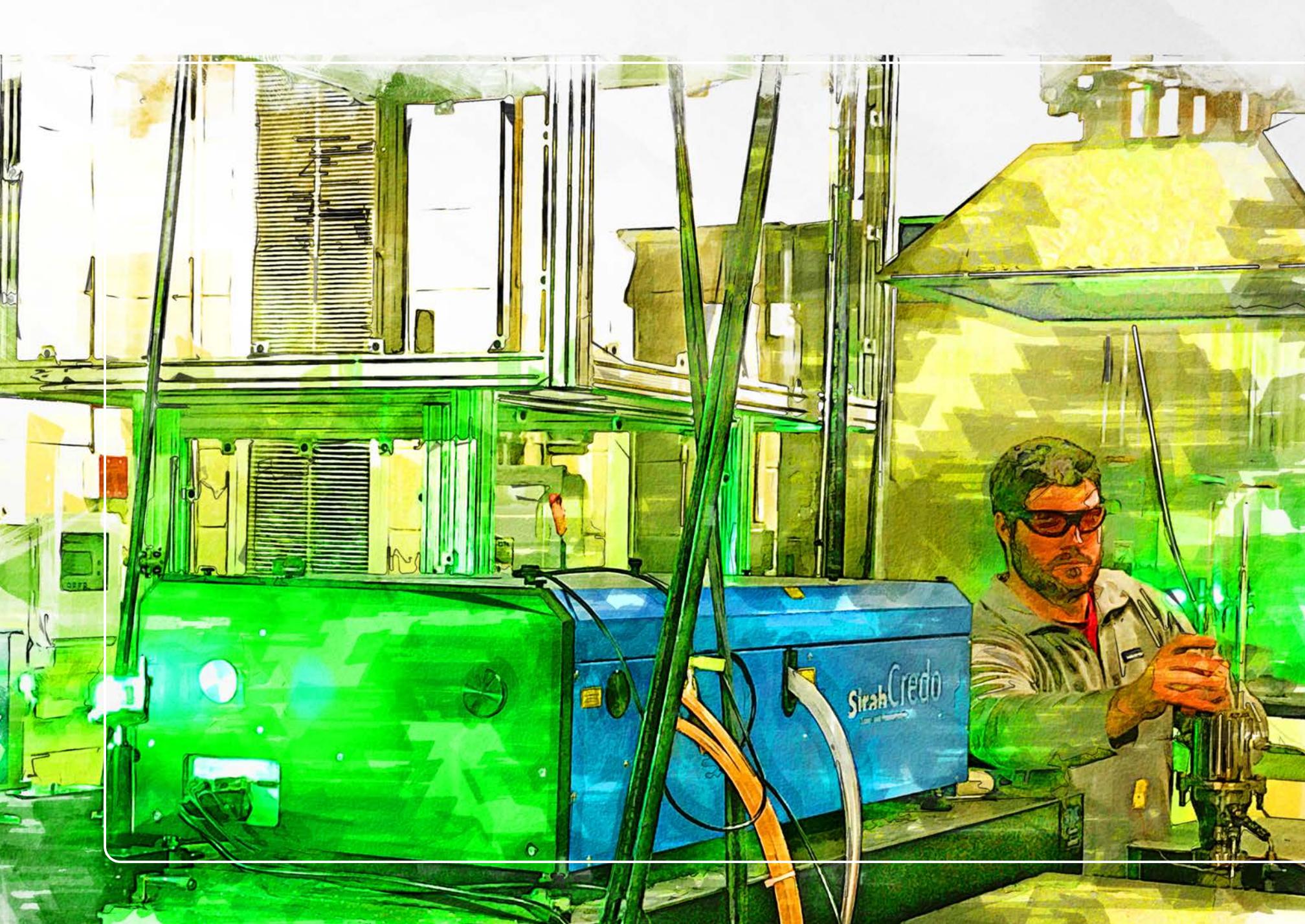
Kindergarten through elementary school resources include activity sheets, engineering design challenges and a storybook.

These resources provide authentic STEM learning experiences using the engineering design process, or computational thinking. These products were tested in May 2019 by 32 educators and partners of NASA Space Grant consortia from 16 states.



Educators participate in testing hands-on STEM learning activities.

Student Learning Opportunities



RESEARCH AND DEVELOPMENT

EPSCoR Driving Research and Development

NASA EPSCoR funded research and development initiatives across 28 states through four solicitations focused on research and research infrastructure, International Space Station (ISS) flight opportunities and rapid-response research awards. In addition this year, EPSCoR briefed the director of the Office of Science and Technology Policy; served on the Office of Budget Management subcommittee on results-oriented reporting; initiated development

of a NASA/National Science Foundation joint research solicitation; conducted a successful directors' meeting and Technical Interchange Meeting with the Jet Propulsion Laboratory; and published the 2018-2019 edition of the *Stimuli* publication, highlighting research reports that demonstrate how EPSCoR research supported NASA's efforts to return to the Moon and then go on to Mars: <https://go.nasa.gov/2PdhIGh>



5 solicitations

100 Cooperative agreements awarded

16 Basic research awards

28 Research infrastructure development awards

26 Research infrastructure development augmentation awards

25 Rapid Response Research (R3)

5 ISS Flight Opportunity awards (had six EPSCoR ISS research projects launch, four return, and currently nine on orbit)

Students work on their NMTSat student-built satellite. NMTSat is funded by the New Mexico NASA EPSCoR program and New Mexico Tech.

MUREP Aeronautics Research Mission Directorate (ARMD) Cooperative Agreements

The MUREP Aerospace High-Volume Manufacturing and Supply Chain Management Cooperative will provide almost \$1.5 million to fund curriculum-based learning, research, training, internships and apprenticeships at three institutions to meet the growing demand for expertise and techniques in high-volume aerospace manufacturing.

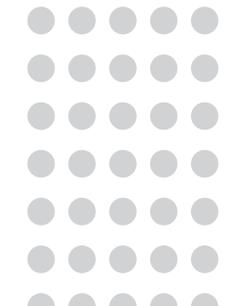
During the next two years, these institutions will develop innovative opportunities for students to learn about designing and building aerospace parts using high-volume manufacturing practices, as well as the supply chain management of those parts.

Selected institutions:

Tuskegee University, Alabama

Virginia State University, Virginia

University of Texas at El Paso, Texas



MUREP Inaugural Innovative and Tech Transfer Idea Competition

MUREP welcomed 50 students and professors from 10 Minority-Serving Institutions (MSIs) at NASA's Johnson Space Center for the inaugural MUREP Innovative and Tech Transfer Idea Competition (MITTIC).

"It was a great experience for our team, and one that I would recommend to anyone working on innovative research and development of spinoff technologies," said Manuel Lobato-Vico, professor at the University of Puerto Rico. "We are committed to continue and want to apply to the NASA Technology Transfer licensing office to build a prototype and, eventually, a commercially viable product."

To meet the requirements, teams chose one NASA Intellectual Property from a provided list and submitted concept papers using MITTIC

challenge guidelines. Up to 10 qualifying teams were then selected to participate in an online collaboration and were funded to travel to Johnson for the immersive on-site experience.

Once participants arrived, they were required to submit a technical concept paper, explain their technical concept and business plan during a poster session and present an oral "lightning pitch" to a panel of judges.

The winners of MITTIC 2019 were students from El Camino College in Torrance, California. Students from El Camino chose to use a Portable Wireless Signal Booster from Johnson. The team received travel funding, one principal investigator visit, a tour and presentation at NASA's AMES Research Center and visits various companies in Silicon Valley in April. This

experience exposed team members to research facilities, laboratories, start-up companies and the opportunity to discuss further development.

NASA internships will be given to 10 MITTIC participants through NASA's Small Business Tech Transfer Office and NASA's Technology Transfer Office, funded by MUREP.

"I am happy to report the Immersion Experience last week was wildly successful for everyone involved, especially the 10 MSIs that were showcased in the Space Tank competition," Program Manager Misti Moore said. "The feedback we received from our technical community and partners has been overwhelmingly positive on the technologies produced by these institutions, and we cannot wait to gear up for round two."



MITTIC participants, professors and leaders pose for photo in the Teague Auditorium on the first day of Space Tank.

MUREP Institutional Research Opportunity

MUREP's Institutional Research Opportunity (MIRO) competitively selected two tribal universities to receive funding to support the training and development of students and faculty in STEM education: Navajo Technical University (NTU) and Sitting Bull College (SBC).

NTU will join eight other universities that were announced earlier this year as a recipient of MIRO's cooperative agreement award. MIRO-selected universities will perform research and education that directly supports NASA's four mission directorates: Aeronautics Research; Human Exploration and Space Operations; Science; and Space Technology.

NTU will use its award to help NASA's Marshall Space Flight Center develop advanced parts for use in the Space Launch System, which may open new possibilities for further space exploration and significantly reduce manufacturing costs and time.

SBC, has received more than \$1 million through NASA's MIRO and MUREP for American Indian Alaska Native STEM Engagement, also known as MAIANSE, a collaborative pilot program. SBC was selected for its submission centered on air-quality research, environmental technology and education on the Standing Rock Reservation. The award will be distributed during the next three years.

SBC plans to work with prominent organizations such as NASA's Langley Research Center in Virginia, NASA's Goddard Space Flight Center in Maryland and the University of North Dakota Atmospheric Science Department to develop a regional research facility.

The SBC Facility for Innovative Atmospheric Research and Education, or FIARE, is envisioned as a ground-based atmospheric composition monitoring station. Students will be able to acquire and report data on ambient air quality as they gain the education and experience required for successful NASA STEM careers.



Research assistants in the Center for Space Exploration Technology Research set up a laboratory-scale turbine combustion rig and high-speed camera. Image Credit: University of Texas at El Paso, cSETR University Research Center



EDUCATOR & INSTITUTIONAL SUPPORT

NASA Museum Alliance

NASA's Museum Alliance is an active community of practice that provides informal educators access to NASA resources. Since navigating NASA's extensive resources can be daunting, the Museum Alliance team provides a human connection and help for informal educators looking to bring NASA to their diverse audiences. The Alliance is also where NASA experts can find an audience ready to help engage students and youth worldwide.

Each year, the alliance presents more than 30 live briefings by NASA experts. In 2019, almost half the presentations related to Artemis and the Apollo anniversaries. The briefings give participants the chance to get information and answers to their questions directly from experts, plus presentation materials, links and resources to use with their own audiences. The recordings and transcriptions are archived on the Museum Alliance member website of searchable resources.

On the public side of the website, the 2019 calendar of events listed more than 700 searchable and sortable mission milestones, trainings, anniversaries and celestial events as well as contest and challenge deadlines.

Notable in 2019 was the success of the collaborative chat forum. Alliance members have embraced this opportunity to communicate with their informal educator peers directly,

sharing best practices and lessons learned. Not surprisingly, planning for the Apollo anniversaries was the most popular topic, but like-minded educators also shared in forums on topics such as planetariums, models and exhibits.

As a result of the resources, expertise and support received, the majority of Museum Alliance members held events commemorating the Apollo 11 Moon landing. These community celebrations ranged from lectures and documentary screenings to multi-day extravaganzas and multi-month special exhibitions.

2,500 professionals

1,100 U.S. organizations

170 International organizations

50 states, plus the District of Columbia and Puerto Rico

38 additional countries



Students work to assemble a puzzle during an event to commemorate the Apollo 11 Moon Landing.



NASA Teams Engaging Affiliated Museums and Informal Institutions

In close collaboration with NASA mission directorates, NASA's competitive award program, Teams Engaging Affiliated Museums and Informal Institutions (TEAM II) enhances the ability of museums, science centers and other informal education institutions and partners to deliver and participate in NASA-based activities. Since the initial competition in FY2008, almost 90 awards totaling more than \$58 million have been made more than 65 organizations in 34 states, plus the District of Columbia. Six NASA Research Announcement (NRA) solicitations have been released under TEAM II and its precursor, the Competitive Program for Science Museums, Planetariums and NASA visitor centers.

Three new awards in FY2019 totaling more than \$2.2 million brings the number of active awards to 22, collectively funded for more than \$18 million in grants and cooperative agreements. Themed on Small Steps to Giant Leaps: Looking to the Future of NASA Innovation and/or Human Exploration Beyond Low-Earth Orbit, the recent projects provide authentic, mission-driven STEM experiences that include: image-processing capability for citizen science using MicroObservatory Robotic Telescopes and kiosks in museums; a new season of PBS' "SciGirls" episodes and role-model videos focusing on girls' space-flown experiments; and a program to engage families and prepare at-risk

youth to participate in "Space City" engineering design competitions for living and working in space. Selected from the 2018 TEAM II NRA, they join three others previously awarded from that solicitation, which provided a new immersive "escape room" inspired STEM game; traveling exhibitions featuring actual Apollo Mission Control Room consoles and interactive mission simulations; and the world's first makerspace in a botanic garden, dedicated to NASA's food production challenges.

Several national network partners will extend the reach of these programs through the Museum Alliance, Smithsonian Affiliate museums, National Informal STEM Education Network, Nation of Makers, Communities in Schools, Challenger Learning Centers and PBS Learning Media.

Released in May, the 2019 TEAM II NRA theme of Moon to Mars celebrates the Artemis Generation, collaborating with the Human Exploration and Space Mission Directorate and the Space Technology Mission Directorate. Forty-seven museums, science centers, planetariums, libraries, youth serving organizations across the United States and other informal education nonprofit organizations submitted proposals. Those awards will be announced in early FY2020.



Students interact with the Apollo Redux experience, designed to celebrate the 50th Anniversary of the Moon Landing. Image Credit: Cosmosphere, Hutchinson, KS

Three new awards in FY2019 totaling
\$2.2M+

22 total active awards

\$18M+
in grants and cooperative agreements

NASA STEM Engagement & Educator Professional Development Collaborative

Educator Professional Development Collaborative (EPDC) provides high-quality STEM engagement and education expertise, guidance and resources. NASA STEM EPDC works with educators at all levels, including university pre-service educators, pre-service teachers, K-12 teachers and informal educators, and engages students of all ages to introduce them to relevant STEM content through exciting NASA STEM contexts.

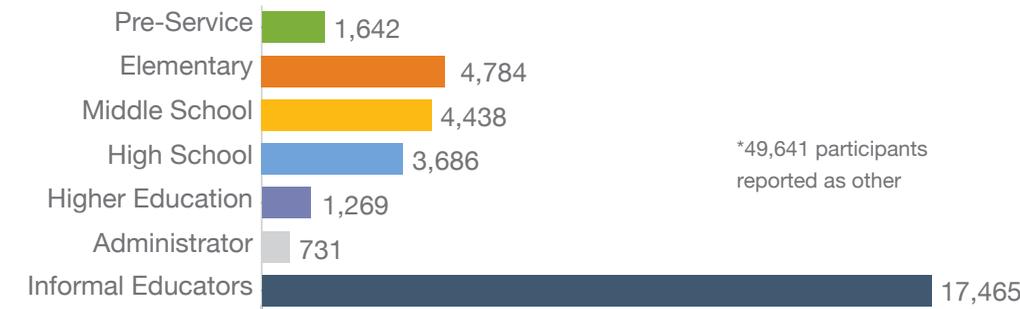
Using a mixed-delivery approach to engage nationwide audiences of students and teachers

with unique NASA and NextGen STEM content, NASA STEM EPDC provides a combination of virtual and face-to-face resources. NASA STEM EPDC leverages virtual learning platforms to provide authentic STEM-engagement opportunities through student and educator webinars, badges and bilingual resources to reach the greatest number of students. NASA STEM EPDC specialists and senior personnel also deliver learning experiences face to face at events, seminars and conferences to serve large groups of students and educators.



Educators participate in a STEM EPDC face to face event.

67,937 total participants



27 digital badges awarded, totaling

154 hours of professional development credit

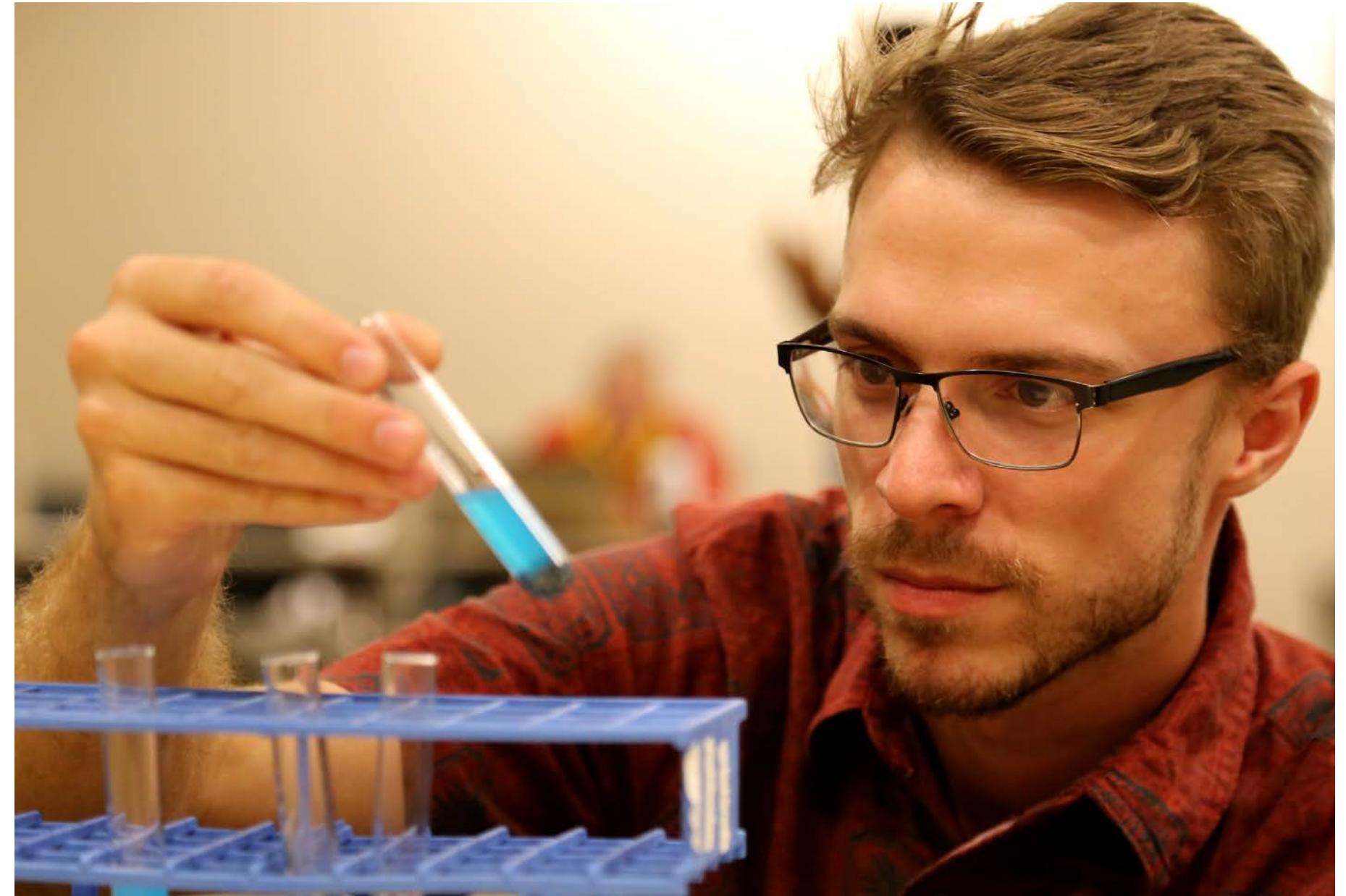
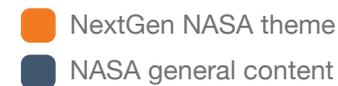
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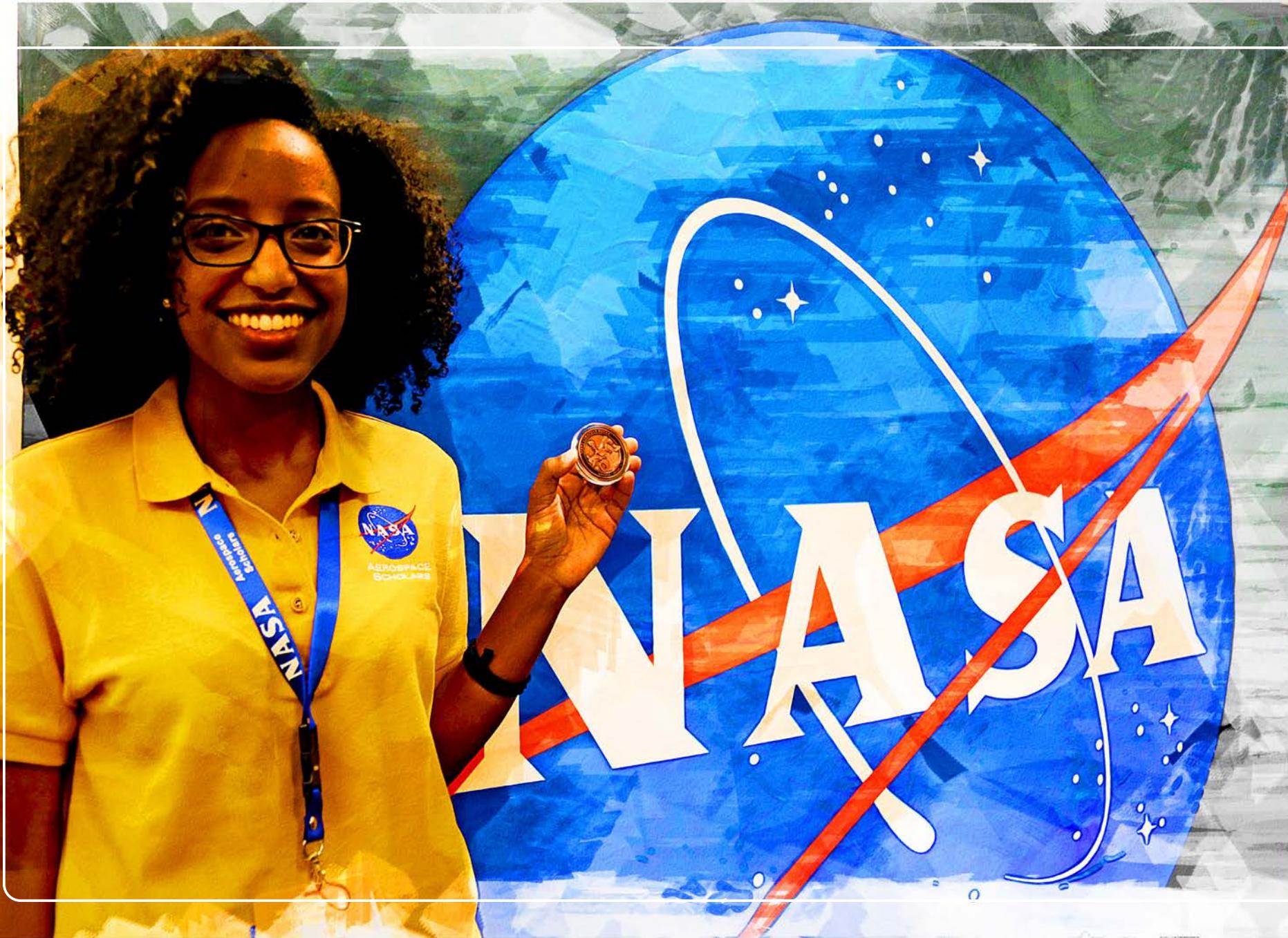
face-to-face events



131

webinars





STRATEGIC
PARTNERSHIPS

STRATEGIC PARTNERSHIPS

NASA has more than 30 Space Act Agreements for STEM-engagement activities with external organizations. The involvement and contributions of NASA STEM professionals are vital to NASA's STEM-engagement efforts. There is benefit in establishing a direct connection to the technical workforce as key stakeholders for STEM engagement, specifically to:

- Serve as advocates for NASA's role and work in STEM engagement
- Stimulate and facilitate participation and contributions by STEM professionals within their respective disciplines/communities
- Assess needs and provide guidance regarding strategies and direction
- Advise on consistency of the STEM-engagement portfolio
- Serve as liaison for technical professionals and provide relevant knowledge regarding technical content

Here's a glimpse of some of the valuable strategic partnerships for NASA STEM Engagement.



Microsoft, Inc.

Hacking STEM Lessons

8 lessons for middle school and high school



addressing the challenges of living in space



Astro Socks were featured on ISS Instagram

U.S. Department of Education



100,000 students participated in engineering design challenges



Partnership with NASA and 21st Century Community Learning Centers

25 states offer STEM-based enrichment to K-8 students, particularly those in high-poverty and low-performing schools, during non-school hours



Tynker, Inc.

Mission Patch Coding Challenge

10,000 entries in one week



5 students won a class chat with a NASA subject matter expert

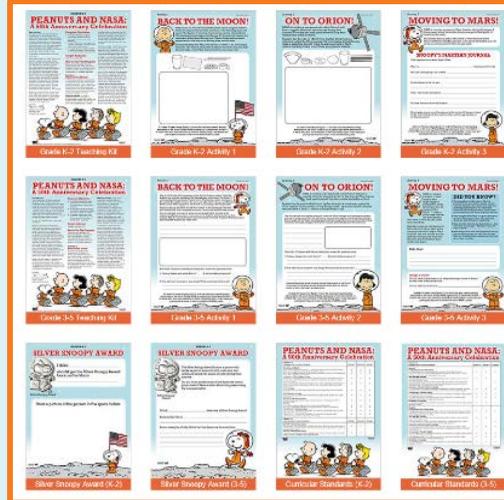
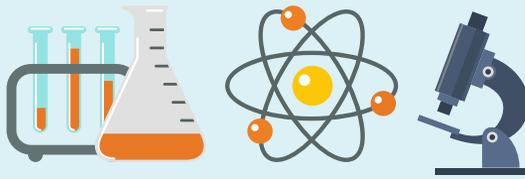


Global challenge in partnership with Tynker Coding for Kids

Peanuts Worldwide™

STEM & Peanuts Partnership

STEM curriculum for K-8 students

Developed STEM content for McDonald's Happy Meals™

Challenger Center



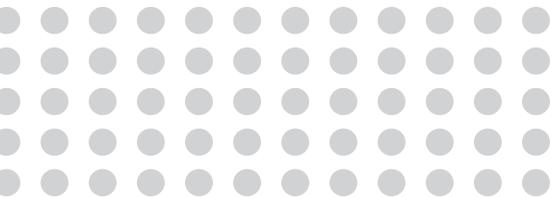
"I touch the future. I teach." -Christa McAuliffe

Completion of Christa McAuliffe's Lost Lessons



NASA astronaut Ricky Arnold debuts Christa's Effervescence lesson for students

FOCUSED FEATURES



International Astronautical Congress (IAC)

The International Astronautical Congress (IAC) is the annual event that brings together all of the players in the development and exploration of outer space. The IAC was held in Washington, D.C. from October 21-25, 2019 and the Office of STEM Engagement played a major role. The Congress was a tremendous success, with more than 8,000 participants.

NASA chaired the 2019 International Space Education Board (ISEB) and worked closely with the American Institute of Aeronautics and Astronautics, who served as the local organizing committee, as well as the 10 ISEB partner agencies.

The program included an educator professional development workshop, which featured Dr. Jane E. Pollock, staff from the Victorian Space Science and Education Center, NASA Commercial Crew Program and NASA Global Learning and Observations to benefit the Environment Program.

The 2019 ISEB cohort included approximately 70 students who had the opportunity to hear from space leaders and other special guest speakers from around the world, including the heads of 10 space agencies. The student program also included participation in research-related activities and a young career panel,

entitled “STEM Careers: Today and in the Future,” which showcased representatives from the Space Generation Advisory Council, Young Professionals Program Committee and NASA’s Office of General Counsel.

For the first time, more than 600 local middle school students converged upon the Congress venue and experienced two days of STEM engagement activities facilitated by 12 STEM organizations. Students were able to meet astronauts during the various panels, which were held during each of the STEM Days.



Left: NASA Administrator Jim Bridenstine answers a question during a Heads of Agency interactive session with students at the 70th International Astronautical Congress, Oct. 21, 2019 at the Walter E. Washington Convention Center in Washington.



Right: Students raise their hands to ask a question during a STEM day session at the 70th International Astronautical Congress, Thursday, Oct. 24, 2019, in Washington

OSTEM 2019 National Broadcasts

The Future of Space

On April 29 at NASA Headquarters in Washington, students participated in a unique learning experience — The Future of Space. This event was in partnership with the American Institute for Aeronautics and Astronautics, Students for the Exploration and Development of Space and NASA’s National Space Grant College and Fellowship Program. Students in the Washington area and across the country heard from host and NASA astronaut Tracy Caldwell Dyson and the NASA powerhouse panel that included NASA Administrator Jim Bridenstine, Associate Administrator for the Human Exploration and Operations Mission Directorate William Gerstenmaier, and Deputy Associate Administrator for Exploration Steven Clarke.



STEM Forward to the Moon

STEM Forward to the Moon, a 30-minute STEM broadcast that was part of NASA’s two-hour Apollo 50th anniversary program, featured middle school students and simulations of returning to the Moon with the Artemis Generation. OSTEM partnered with museums and science centers, with each location demoing an interactive science experiment that viewers could also follow along with, whether in their own homes or at partner locations. The STEM experiments and broadcast aimed to inspire the next generation of explorers to dream big and take the next steps forward to the Moon and on to Mars.



Space & STEM: Where Do You Fit In?

The Office of STEM Engagement presented a live broadcast, “Space & STEM: Where Do You Fit In?” from NASA Headquarters and the 2019 International Astronautical Congress. The event featured NASA Administrator Jim Bridenstine, along with NASA senior leadership, astronauts and young professionals, to provide insight on their experiences and inspire the Artemis Generation to take an active role in NASA’s efforts to send the first woman and next man to the Moon. Interspersed between panels featuring either young professionals, senior leadership and astronauts, videos highlighted the advancements of young people, all to get involved and be part of the NASA mission.



Notable Milestones: Space STEM Forum & Apollo 50th Anniversary



SpaceSTEM.NASA.gov

Largest interactive Apollo anniversary event compilation

- 1M attendees at listed events
- More than 300 events at 240+ sites from July 19 - 20, 2019



STEM Forward to the Moon Broadcast

NASA broadcast from four museums (Apollo and Artemis)

- 27,165 combined social media engagement
- 30K+ views on YouTube with 1,299 live streams



Spaceflight Jr. Ranger Guide

STEM content in partnership with the National Park Service

- Spaceflight Explorer, Junior Ranger Activity Guide
- 50K+ distributed to 50+ National Parks



#VirtualMoonshot

NASA lunar STEM social media student event

- 18 host centers; 560K social media following
- Total reach: 6,108 users
- Total engagement: 4,303 users



Forward to the Moon with Artemis

Primary STEM activities on Artemis and Apollo

- 100K distributed to NASA Centers, libraries, Challenger Learning centers, museums and Solar System Ambassadors.
- 74 organizations in 28 states



STEM Apollo Watch Party/Media Kit

STEM kit for museums and youth-serving organizations

- Resources and draft media advisory to publicize Apollo events
- More than 2,300 page views



Museum Alliance Lunar Webinars

13 STEM webinars on Apollo and Artemis

- Live attendance 1000+
- 4000+ downloads of archived recordings and materials



Apollo Anniversary STEM on National Mall

Interactive student-based STEM engagement activities

- Cosmosphere's Apollo Redux exhibit
- 10 STEM activities, with over 21K NASA items distributed
- More than 2K participated in scavenger hunt and over 10K interactions with general public

NASA Technology Infusion Road Tour

Led by NASA's Office of STEM Engagement, the NASA Technology Infusion Road Tour was a multi-day forum that resulted in the opportunity for Minority Serving Institutions (MSIs) to collaborate with members of NASA's Offices of Procurement, Small Business Programs and Small Business Innovation Research/ Small Business Technology Transfer. Leaders from various NASA mission directorates also shared opportunities available in their respective

organizations. With the road tour hosted on three MSI campuses, representatives from various MSIs showcased their research capabilities and increasing collaboration with federal partners. NASA, along with other federal agencies, participated in networking activities, including tours of the host MSI research facilities and a matchmaking session. NASA continues to expand its reach and is the only federal agency with a 1% goal for contracts with MSIs.



Photos from various MSI campuses included in the NASA Technology Infusion Road Tour.

Road Tour by the numbers

36 total MSIs

330 total attendees

Tuskegee University

April 2019

11 MSIs 80 attendees

New Mexico State University

August 2019

12 MSIs 90 attendees

University of Puerto Rico

November 2019

13 MSIs 160 attendees

Students from Texas Make History and Celebrate a Historic Moment

Since 2017, students from Lone Star College-CyFair in Texas, Team CERO, have been hard at work developing their tool design to solve a space walk challenge. Through support from the Texas Space Grant Consortia and placing third in the Texas Space Grant Consortia Design Challenge, their proposal was selected for the 2018 cycle of Micro-g Neutral Buoyancy Experiment Design Team or Micro-g NExT.

Their evolutionary design for a zip-tie cutter opened up more possibilities. The following year, in spring 2018, the team participated in both programs. Not only did they win the Texas Space Grant Consortia Design Challenge, but they also won with Micro-g NExT. Team CERO's zip-tie cutter tool underwent testing in May 2019, and it surpassed the engineers' expectations so much so that they were invited back to develop their tool further for testing with NASA's Active Response Gravity Offload System.

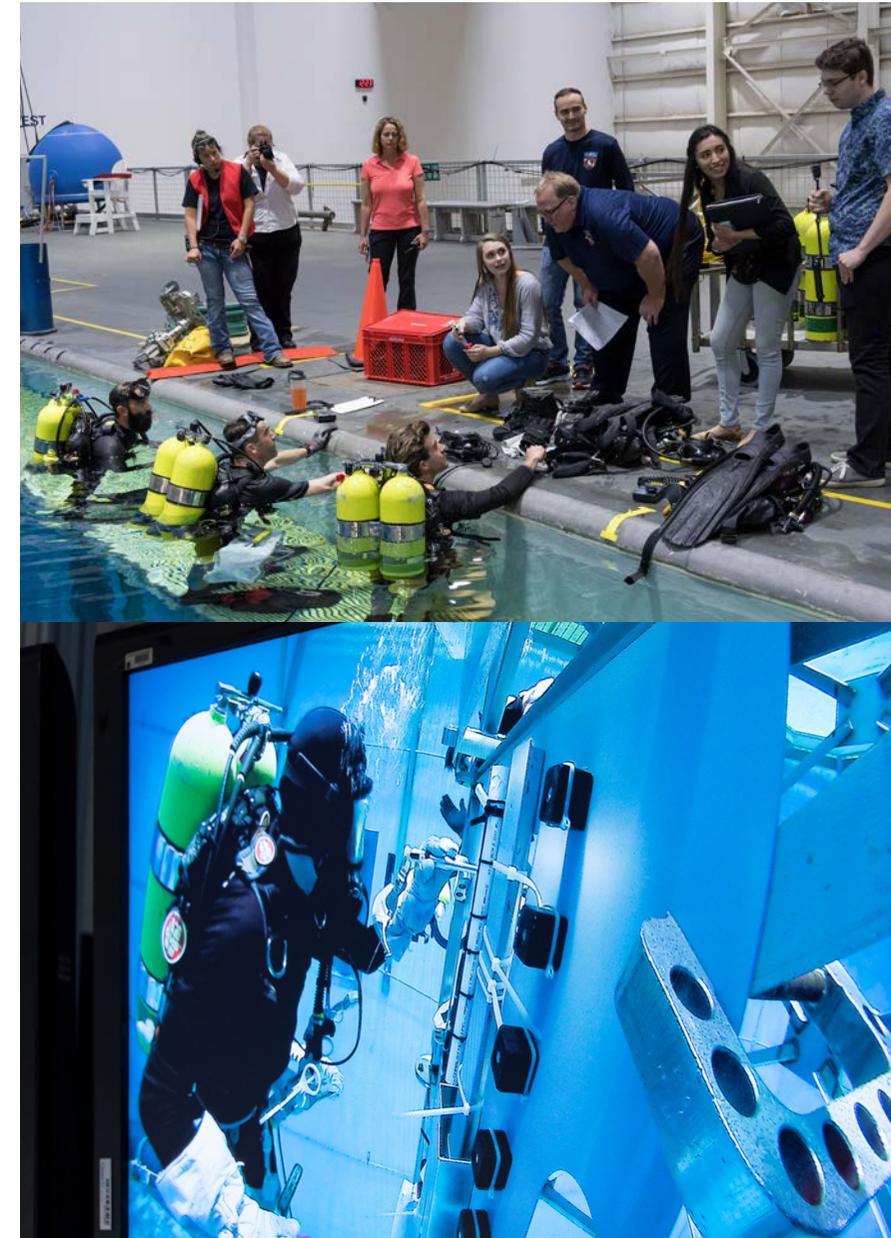
The device, created thanks to Micro-g NExT, was the first to have been flight certified and flown to the space station. It was used by astronaut Luca Parmitano to aid in the repair of the Alpha Magnetic Spectrometer on Nov. 15, 2019.



Astronaut Luca Parmitano uses the zip-tie cutter during a spacewalk to repair the Alpha Magnetic Spectrometer on Nov. 15, 2019. Image Credit: NASA

“The work of our students surpassed all expectations. Through our participation in this challenge, we have realized the value of providing an end-to-end design experience to students in the first two years of their engineering study.”

– Jared Cammon
Faculty advisor

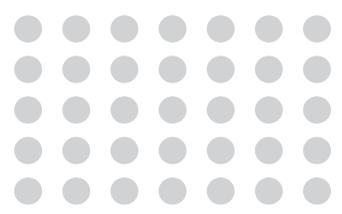
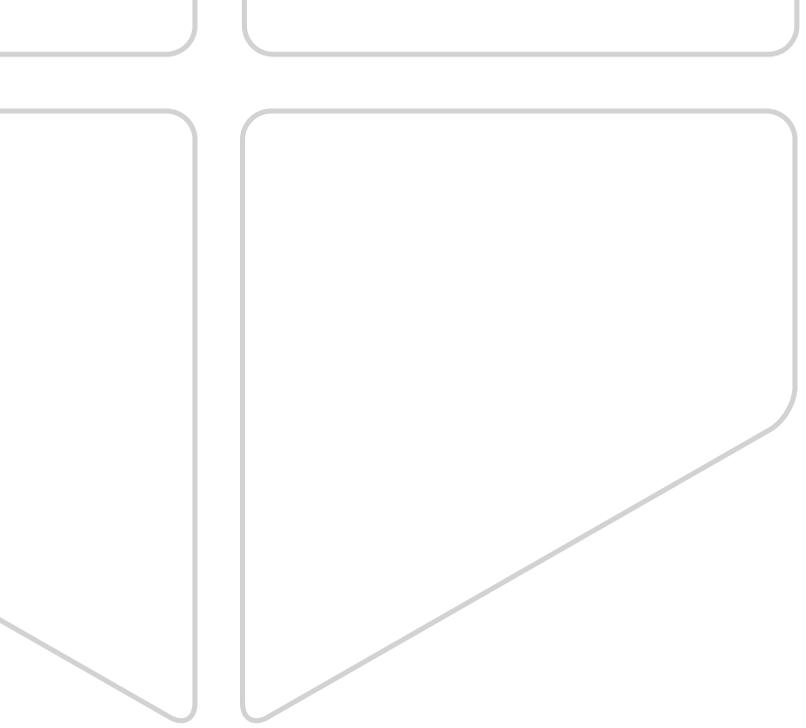


Clockwise:

Team members guide divers at the Neutral Buoyancy Laboratory (NBL) as their developed tool is tested.

The student team from Lone Star College-Cy Fair, which participated in Micro-g NExT, pause for a photo with NBL support staff and their zip-tie cutter, which is expected to be used in space in 2019.

The zip-tie cutter, a novel new tool designed by Lone Star College-Cy Fair students, is evaluated underwater at NASA Johnson Space Center's NBL.



LINK INDEX

NASA Office of STEM Engagement Links

NASA Office of STEM Engagement	stem.nasa.gov
Minority University Research and Education Project (MUREP)	nasa.gov/stem/murep
Established Program to Stimulate Competitive Research (EPSCoR)	nasa.gov/stem/epscor
National Space Grant College and Fellowship Project (Space Grant)	nasa.gov/stem/spacegrant
NextGen STEM.....	nasa.gov/stem/nextgenstem
STEM Student Challenges	nasa.gov/joinartemis
NASA Internships	intern.nasa.gov
NASA Museum Alliance	informal.jpl.nasa.gov
NASA EXPRESS.....	www.nasa.gov/stem/express

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www.nasa.gov

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