



NASA STEM

Highlights **2023**



Cover: Students from Houston area schools pose for a picture at the Artemis II Crew Announcement at Ellington Field - Hangar 135. Credit: NASA

During a visit to the Martin Luther King Jr. Memorial Library in Washington, D.C., NASA astronauts Bob Hines, Kjell Lindgren and Jessica Watkins answered questions from elementary students and then helped conduct science demonstrations led by the Center of Science and Industry of Columbus, Ohio. Credit: NASA

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Casey Denham, aerospace engineer, works with tribal students during a STEM activity at the American Indian Science and Engineering Society (AISES) National Conference. Credit: NASA



Letter from the Administrator

As we press ahead to expand humanity’s reach in space for the benefit of life on Earth, we recognize the importance of a robust, diverse workforce, now and in the future. It is essential that we engage today’s students and connect them to NASA’s missions and work, not only to open their eyes to all the fascinating career possibilities in science, technology, engineering, and mathematics (STEM), but ultimately to help strengthen tomorrow’s workforce pipeline with a new generation of talent.

The benefits of these efforts extend beyond NASA to the entire national STEM ecosystem. When young learners engage with NASA and experience that spark of inspiration, we must nurture that interest through continued opportunities for further engagement, retaining students on pathways to an exciting and varied array of STEM careers.

We accomplish these objectives by attracting diverse groups of students to STEM through meaningful learning opportunities, creating ways for students to contribute to NASA’s work in exploration and discovery, and engaging students in authentic experiences with our world-class workforce and facilities.

Our STEM Engagement activities and opportunities broaden student participation, ensuring we reach students who have historically been underserved and underrepresented in STEM. Talented people come from everywhere, all backgrounds, and all walks of life. We want to empower them to become the bright minds that fuel the agency’s missions of tomorrow.

One of the highlights of my job as NASA’s administrator is meeting and engaging with students of all grade levels, from kindergartners to our own NASA interns. Their excitement is contagious, and their enthusiasm for the future we’re building together is inspiring. We’re determined to continue providing new resources and opportunities for them to chase their STEM dreams and help make America’s exploration plans a reality.

Why NASA Invests in Engaging the Nation’s Students in STEM

The scope of NASA’s STEM engagement investments comprises all endeavors to attract, engage, and educate students and to support educators and educational institutions. By investing in today’s students, NASA is building the highly capable, diverse STEM workforce our nation will need to accomplish our long-term goals in aeronautics and space exploration.

Given the nation’s need and projected demand for a skilled STEM workforce, NASA has a vested interest in appealing to and helping to prepare its future STEM professionals. The national STEM ecosystem benefits from NASA contributions to attract and retain students on STEM pathways, particularly those from diverse and historically underrepresented backgrounds. Recent national and international tests show that in the last decade, U.S. students have demonstrated little or no growth in mathematics and remain ranked in the middle of advanced economies on international science and mathematics assessments. While the number of women and underrepresented minorities earning STEM degrees has grown in broad science and engineering occupations over the last decade, significant underrepresentation remains in areas critical to NASA, such as engineering and computer and mathematical sciences.

NASA makes vital investments in a diverse portfolio of learning opportunities and impactful activities designed to engage as many U.S. students and educators as possible from kindergarten through graduate school, and through venues from the local library to the university. NASA is uniquely positioned to use its platform of exciting missions and world-class experts to aid in building a skilled STEM workforce – our next generation of explorers – with the technical skills needed to carry forward our nation’s vital work in aeronautics and space into the future.

NASA’s STEM Engagement Goals

- Create unique opportunities for a diverse set of 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.
- Attract diverse groups of students to STEM through learning opportunities that spark interest and provide connections to NASA’s mission and work.

Our Beneficiaries

NASA’s STEM Engagement efforts reach every U.S. state and most of the nation’s territories. The beneficiaries of NASA’s investments and work in STEM engagement are students in grades K-12, undergraduate, and graduate levels. While NASA’s work in STEM engagement is ultimately focused on serving students, providing support to educators and formal and informal education institutions is vital to effectively engage students.

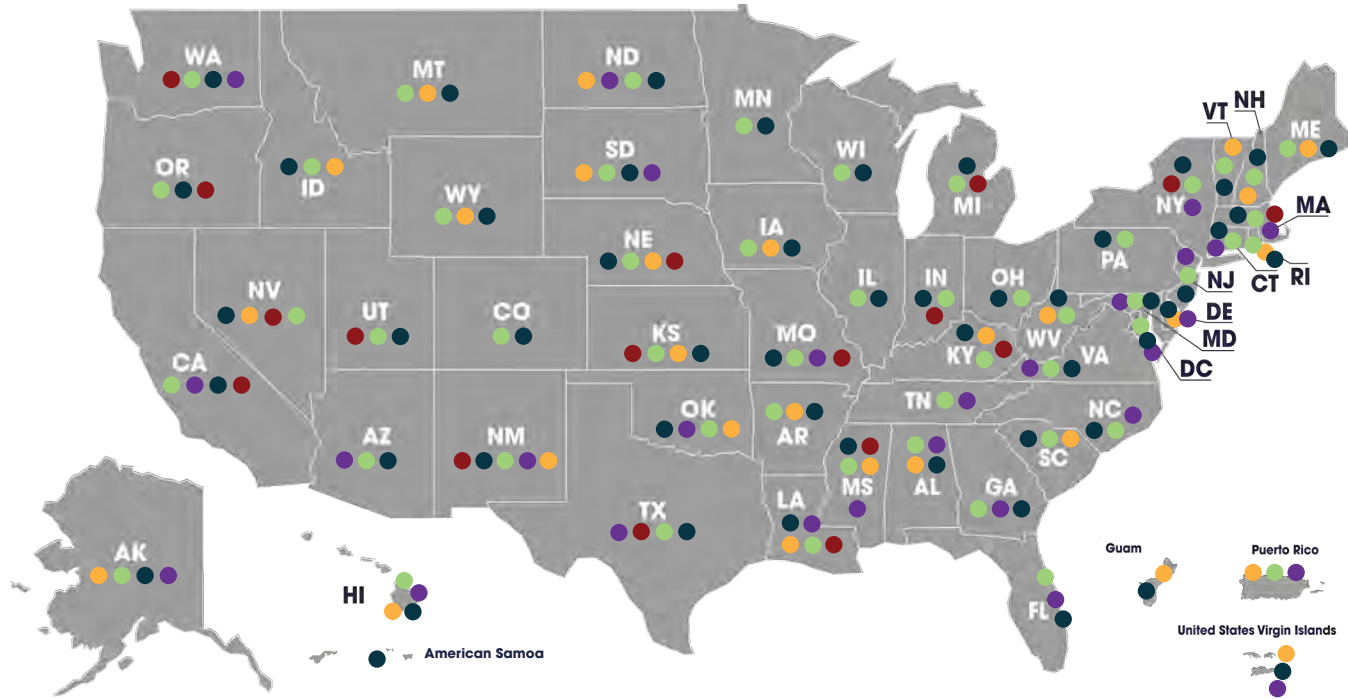
NASA’s Investment in the Nation’s Future STEM Workforce

Our STEM Engagement endeavors represent a collaborative effort encompassing the activities of NASA’s Office of STEM Engagement (OSTEM) and the mission directorates: Aeronautics Research Mission Directorate (ARMD), Exploration Systems Development Mission Directorate (ESDMD), Science Mission Directorate (SMD), Space Operations Mission Directorate (SOMD), and Space Technology Mission Directorate (STMD), as well as NASA centers and facilities, to maximize the agency’s reach and impact. NASA is committed to inspiring the students of the Artemis Generation and supporting the educators and caregivers who guide them to discover their own unique skills, interests, and capabilities.

In FY 2023, OSTEM managed the \$143.5 million budget appropriated by Congress and provided guidance and strategic direction of the agency’s STEM engagement portfolio. OSTEM investments encompass four projects: the 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 (Next Gen STEM).

Collective STEM Engagement Impacts

In FY 2023 (Oct. 1, 2022 – Sept. 30, 2023), NASA impacted 768K+ students and 112K+ educators through STEM engagement activities, opportunities, awards, and content.



- MUREP • \$45.5 million**
 NASA's Minority University Research and Education Project (MUREP) expands the agency's reach in communities historically underrepresented in STEM. MUREP offers opportunities for college students at Minority Serving Institutions to contribute to the agency's exploration goals and also boosts these schools' research capacity and infrastructure. NASA invests in the Artemis Generation and a diverse future workforce through MUREP's competitive awards, research opportunities, and engagements at career fairs and conferences.
- Space Grant • \$58 million**
 NASA's National Space Grant College and Fellowship Project (Space Grant) brings together partners from across academia, industry, and government to invest in STEM education and research. Space Grant's 52 consortia — one in each state as well as Puerto Rico and the District of Columbia — connect more than 1,251 affiliated institutions to fund fellowships and awards and create enriching STEM opportunities for Americans to understand and participate in NASA's aeronautics and space projects.
- EPSCoR • \$26 million**
 The Established Program to Stimulate Competitive Research (EPSCoR) establishes partnerships with government, higher education, and industry that are designed to effect lasting improvements in a state or region's research infrastructure, research and development capacity, and its national research and development competitiveness. The NASA EPSCoR project is directed at those jurisdictions that have not participated equitably in competitive aerospace and aerospace-related research activities. Twenty-five states, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, and Guam currently participate.
- Next Gen STEM • \$14 million**
 NASA's Next Gen STEM project is an integrated portfolio of grants, partnerships, activities, educational products, and student opportunities designed to engage K-12 students nationwide in the agency's missions, people, and resources. The project's efforts aim to inspire the STEM workforce of tomorrow by bringing the excitement of NASA to students, whether in the classroom, at home, in afterschool programs, or in informal education settings.
- SciAct • \$52 million**
 The NASA Science Mission Directorate Science Activation (SciAct) program connects NASA science with diverse learners of all ages in ways that activate minds and promote a deeper understanding of our world and beyond, with the ultimate goal of increasing participation in the advancement of human knowledge. SciAct operates through a cooperative nationwide network of three dozen competitively selected and community-based teams and several activities at NASA centers.

Internships, Fellowships, and Other Higher Education Awards

9,584

internships, fellowships, research opportunities, educator professional development, challenges, and other college/pre-college STEM engagement opportunities

\$44.3M

in direct financial support of student and educator participants representing K-12 institutions and higher education institutions including 2-year, 4-year institutions and all Minority Serving Institution (MSI) classifications

32.4%

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

43.2%

of higher education internships and fellowship positions were filled by women, up from 39.5% in FY 2018

*Underrepresented racial categories (American Indian or Alaskan Native; Black or African American; and/or Native Hawaiian or Pacific Islander)
 ** Underrepresented ethnicity (Hispanic or Latino)

Research and Development

3,577

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

61%

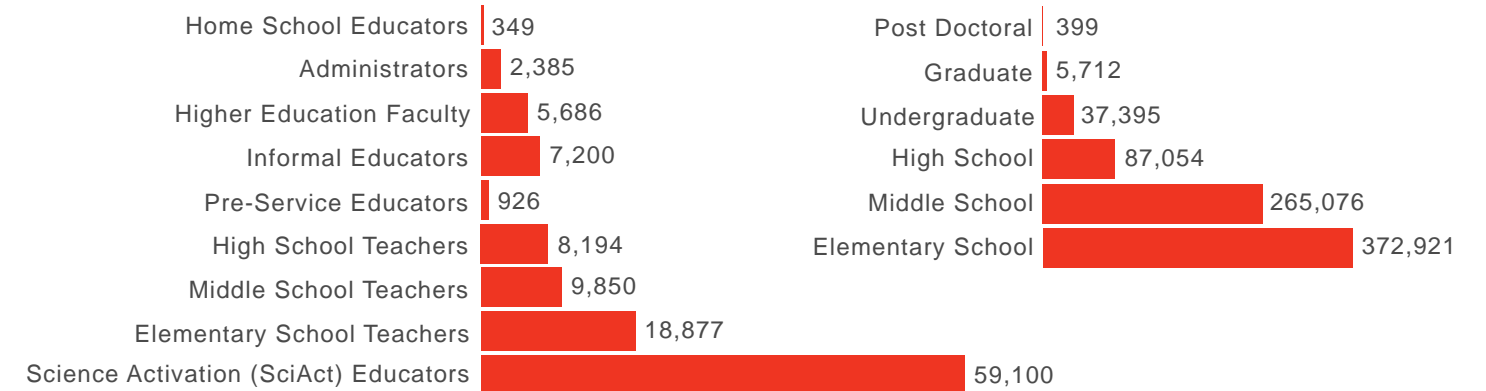
of peer-reviewed publications were authored or coauthored by students

51 patents awarded to higher education institutions as a direct result of their NASA STEM Engagement grants or cooperative agreements

Educator Participants

112K+

educators participated in NASA STEM engagement training activities*



Student Participants

768K+

students participated in NASA STEM engagement activities*

Other Participants

80.3M+

Other Participants represents general public participants (e.g., uncategorized students of all ages, parents, educators, and adult participants) reached through collective STEM engagement investments, including 75.8M SciAct learners.



Inspiring America's Youngest Explorers

NASA's K-12 Efforts

Today's students are tomorrow's scientists, engineers, and explorers, and NASA is invested in inspiring them to reach to the stars. NASA develops and deploys evidence-based opportunities to engage K-12 students in NASA-unique learning experiences both inside and beyond the classroom. NASA sparks student curiosity using a variety of lesson plans, hands-on experiences, and engagements that teach STEM concepts and excite students about NASA's missions.

In FY 2023 NASA engaged the nation's youngest explorers in missions that could help define their generation, including America's return to the Moon, understanding and protecting our home planet Earth, and experiencing new windows of the universe through the eyes of the James Webb Space Telescope. This fiscal year, students watched NASA's first Artemis mission to the Moon take flight, had 19 opportunities to speak with astronauts on the International Space Station, learned about exciting STEM careers at NASA, contributed to future spaceflight through Artemis Student Challenges, and much more.

Previous page: Students from Houston area schools pose for a picture with NASA Astronaut Joe Acaba at the Artemis II Crew Announcement at Ellington Field.

Credit: NASA

Top: A group of students and their chaperones gather in the John Holliman Auditorium of the News Center to simulate a news conference during a tour of NASA's Kennedy Space Center in Florida in October 2022. Some of them are seated at the dais at the front of the auditorium.

Credit: NASA

Bottom: Audience members watching a live stream of the Orion splashdown at San Diego Air and Space Museum in December 2022. Credit: NASA

The Artemis Generation Takes Its Place in History

The Artemis I flight test, which launched from NASA's Kennedy Space Center in Florida on Nov. 16, 2022, was the first in a series of increasingly complex missions that will enable human exploration at the Moon and future missions to Mars. As the Space Launch System rocket rose from the pad, a new generation was launched with it: the Artemis Generation. And NASA is bringing these explorers of tomorrow along for each step of these historic missions.

Launching Artemis I With the Next Generation of Explorers

On Nov. 16, 2022, 48 middle-school students got the trip of a lifetime to witness the launch of Artemis I from NASA's Kennedy Space Center in Florida. The students' experience was part of Students to Launch, a program funded by the American Institute of Aeronautics and Astronautics (AIAA) in collaboration with NASA. The young explorers had the opportunity to hear from NASA subject matter experts, participate in hands-on STEM activities, and witness history being made on the launch pad.



Orion Splashdown Watch Party

About 500 students and families joined special guests and NASA experts to watch live as the agency's Orion spacecraft splashed down off the coast of Baja California on Dec. 11, 2022. Hosted at the San Diego Air & Space Museum, the watch party featured special guest Snoopy, fresh from serving as the zero-gravity indicator during the uncrewed Artemis I mission. Also in attendance were Najoud Merancy, chief of the exploration mission planning office at NASA's Johnson Space Center; Kamak Ebadi, robotics technologist in aerial and orbital image analysis at NASA's Jet Propulsion Laboratory; Department of Education Deputy Secretary Dr. Cindy Marten; Carol Dedrich, CEO of Girl Scouts San Diego; and Congressman Dr. Scott Peters of California's 52nd Congressional District.



Post-Mission Briefing for Students

Thousands of students from across the country learned about the Artemis program directly from subject matter experts during the Artemis Student Press Event held Jan. 19, 2023, at Kennedy Space Center. The event was broadcast on NASA TV and featured panelists Kelvin Manning, deputy director of Kennedy Space Center; Artemis Launch Director Charlie Blackwell-Thompson; Elkin Norena, Space Launch System resident management office manager; and U.S. Space Force Weather Officer Melody Lovin. Two local classrooms attended in person, with many more participating and asking questions virtually. Students then collaborated to write a summary of the event to be published as a feature on NASA.gov.



Top: NASA Launch Director Charlie Blackwell-Thompson, NASA Space Launch System (SLS) Chief Engineer John Blevins, and U.S. Space Force Launch Weather Officer Melody Lovin, briefed students in January 2023 at Kennedy Space Center. Credit: NASA

Bottom: The Artemis II crew, from left to right, Victor Glover, Reid Wiseman, Christina Hammock Koch and Jeremy Hansen wave to area students during the Artemis II Crew Announcement at Ellington Field. Credit: NASA

Introducing the Artemis II Crew to Artemis Generation Students

On April 3, 2023, NASA and the Canadian Space Agency (CSA) revealed the four astronauts who will venture around the Moon on Artemis II: Commander Reid Wiseman, Pilot Victor Glover, Mission Specialist 1 Christina Hammock Koch, and Mission Specialist 2 Jeremy Hansen. The event took place at Ellington Field near NASA's Johnson Space Center in Houston. In attendance were elementary school students from Houston Independent School District and Clear Creek Independent School District, who took part in hands-on activities with NASA interns. The day after the announcement, students from Deady Middle School in Houston visited Johnson Space Center for hands-on STEM activities with a few special guests: the Artemis II crew!



NASA astronauts and Expedition 70 Flight Engineers Loral O'Hara, left, and Jasmin Moghbeli, right, work on a spacesuit aboard the International Space Station's Quest airlock. Credit: NASA

Opposite: Expedition 70 Flight Engineers (from left) Jasmin Moghbeli and Loral O'Hara, both from NASA, pose for a portrait inside the Destiny laboratory module following the successful docking of the SpaceX Dragon cargo spacecraft to the International Space Station. Credit: NASA



In-Flight Education Downlinks

Students Get Questions Answered From Space

In FY 2023, students engaged with astronauts aboard the International Space Station during 19 space-to-Earth calls. During these interactions, called downlinks, astronauts aboard the station in low Earth orbit answer prerecorded questions from students. Over 58,000 people watched these interactions live on NASA TV and the recordings have earned over 77,000 views on YouTube.

Notable in FY 2023 were two downlinks in which tribal students had the opportunity to connect and be inspired by NASA astronaut Nicole Mann, who made history in October 2022 when she became the first Native American woman to fly to space.

Mann answered questions from students from the Boys & Girls Club of the Flathead Reservation and Lake County in Ronan, Montana, on Jan. 26, 2023, and then from students at Choctaw Nation Head Start, Jones Academy Elementary, and seven area public schools in Durant, Oklahoma, on Jan. 31, 2023. Students and tribal members got a firsthand look at living and working in space, inspiring the next generation to pursue STEM. Downlink opportunities allow educators to align NASA STEM lessons to students' STEM curriculum.

[Learn More](#) →



FY 2023 DOWNLINK PARTICIPANT NUMBERS

19 Downlinks

58K+ Live Viewers



Above: Girl Scout leaders Heather McKinney, Patricia Ochoa, and Stephanie Rodriguez compare their views of the sun through their “cereal box” pin-hole viewers to that of the Coronado Solar Telescope
Credit: Scobee Education Center

Bringing NASA to Students

Supporting STEM Learning in Communities and Informal Education Spaces

NASA’s Next Gen STEM project’s **Teams Engaging Affiliated Museums and Informal Institutions (TEAM II)** competitive award opportunity inspires the next generation of explorers by helping museums, science centers, and other informal education institutions and their partners bring NASA STEM content to their communities.

Active during FY 2023 were 56 awards to such institutions in 32 states and Puerto Rico. During the fiscal year, these awarded projects directly served 59,111 students and 4,222 educators. They also served an additional 4,054,962 members of the general public who engaged with supported efforts, such as by visiting a museum exhibit or viewing a planetarium show.

TEAM II Full Awards are competitively awarded to expansive projects by museums, libraries, and youth-serving organizations and their learning support systems that involve NASA, partnerships with regional or national networks,

and independent evaluation. Awarded projects enhance the capability of informal education institutions to host NASA-based learning activities while increasing the institutions’ capacity to use innovative tools and platforms to bring NASA resources to students.

In March 2023, four new TEAM II Full Awards were announced. They will receive approximately \$3.1 million in cooperative agreements for projects implemented over the next three years. They joined 13 previously awarded projects in implementation for a combined 17 active awards. In addition to the TEAM II Full Awards, institutions can apply to become a TEAM II Community Anchor. This designation recognizes an organization as an important local hub for space and STEM learning, establishing a NASA presence and nurturing connections between NASA and students in the community.

In spring 2023, the second cohort of 17 Community Anchors was announced. The projects span 17 states and are designed to share authentic STEM experiences with diverse audiences. Members of the first cohort, announced in 2022, continued their projects throughout the fiscal year.

[Learn More](#) ➔

Opposite: Visitors to the “Moon, Mars, and Beyond” exhibit explore a jigsaw puzzle touch table, one of several low-barrier-to-entry components in the exhibit.
Credit: Space Science Institute



TEAM II FY 2023 Highlights:

THE SPACE SCIENCE INSTITUTE

Boulder, Colorado

TEAM II Full Awardee

The Space Science Institute partners with public libraries to increase patrons’ interest in and engagement with NASA’s Artemis program. This fiscal year, the interactive exhibit “From Our Town to the Moon, Mars, and Beyond” and associated library programs reached over 60,000 people as it traveled to libraries in Arizona, Iowa, New Hampshire, New York, and Connecticut.

THE BELL MUSEUM

St. Paul, Minnesota

TEAM II Full Awardee

The Bell Museum at the University of Minnesota completed creation of a full-dome planetarium show, “Mars: The Ultimate Voyage,” about the human factors of long-distance spaceflight. The show, along with a toolkit of related informal science activities, is part of the Bell Museum’s regular planetarium schedule and has been licensed to 14 planetariums across the country.

SCOBEE EDUCATION CENTER

San Antonio, Texas

Community Anchor

Located on the 2024 total solar eclipse path of totality, the Scobee Education Center focused on preparing educators to lead eclipse events around San Antonio. The Center’s four-day Teachers Academy welcomed STEM leads from 20 local schools serving more than 11,000 students in six different school districts. The Center also hosted a workshop for 17 area Girl Scout troop leaders to share fun ways to teach about the Sun and how to view the solar eclipse safely.

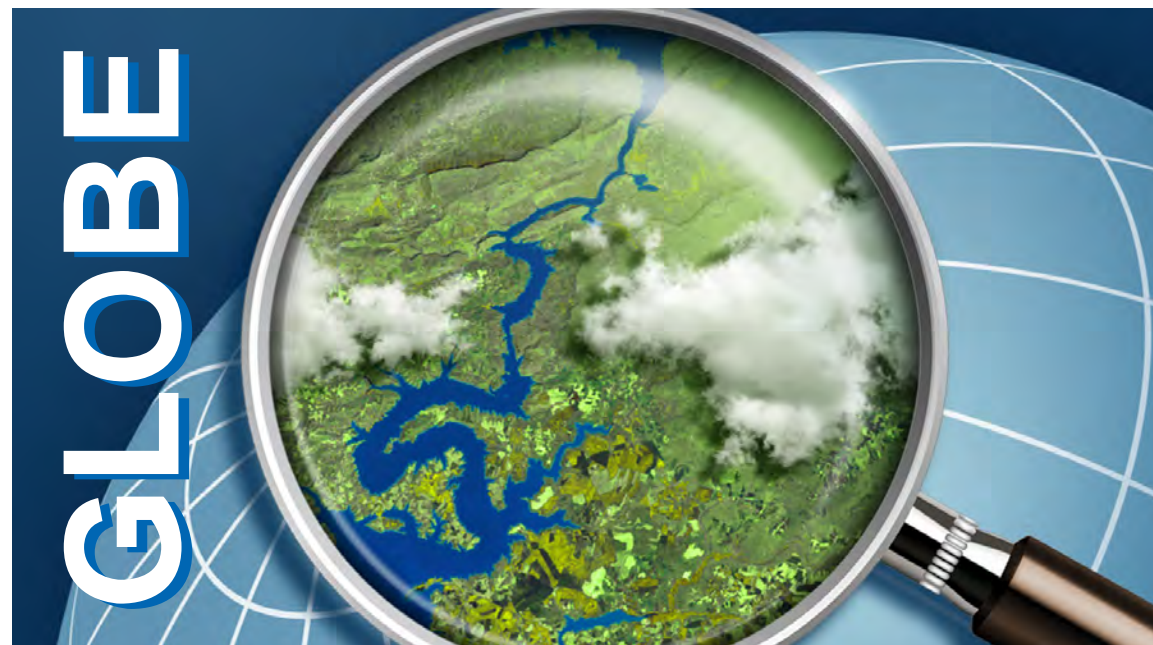
FY 2023 TEAM II PARTICIPANT NUMBERS

59K+ Students **4K+** Educators

Bottom left: GLOBE SRS participants on a boat tour of Lake Mendota in Wisconsin. Credit: GLOBE

Bottom right: Students at the Northwest SRS in Alaska do a "GLOBE caching" activity measuring snowpack depth. Credit: GLOBE

Opposite: Students participate in an Earth Information Center (EIC) student engagement event in June 2023 at the Mary W. Jackson NASA Headquarters building in Washington. The EIC is a new immersive experience that combines live data sets with cutting-edge data visualization and storytelling to allow visitors to see how our planet is changing. Credit: NASA



Interconnected Earth

GLOBE (Global Learning and Observations to Benefit the Environment)

The GLOBE (Global Learning and Observations to Benefit the Environment) Program brings together students, educators, volunteers, and researchers worldwide to improve our understanding of the interconnected Earth systems. Through GLOBE, students learn about the challenges of climate change, water quality, plastic trash, and snow depth. GLOBE introduces scientific principles and program protocols enabling participants to conduct their own research and explore topics relevant to their communities.

In FY 2023, more than 200 U.S. students in grades 5-12 presented 86 research projects at four Student Research Symposia nationwide. Also participating were 20 U.S. GLOBE partners representing 10 partnerships; 45 educators; and 54 additional reviewers, scientists, and support personnel.

[Learn More](#) →



temperatures are Rising

FY 2023 GLOBE PARTICIPANT NUMBERS

86 Research projects **20** U.S. GLOBE partners

Introducing Students to NASA Careers

Top: NASA engineer Dr. Peter Peterson, prepares a high-power Hall thruster for ground testing in a vacuum chamber. Credit: NASA



Middle: Spencer Wells, a mechanical engineering technician, welds a part of a camera enclosure inside the Prototype Development Laboratory at NASA's Kennedy Space Center. Credit: NASA



Bottom: Wendy A. Okolo, Ph.D., aerospace engineer, works in the Intelligent Systems Division at NASA's Ames Research Center. Credit: NASA



Opposite: NASA diver Arielle Valdez assists a NASA astronaut during training in the Neutral Buoyancy Lab at Johnson Space Center in Houston. Credit: NASA

Surprisingly STEM Series Gives Students a Fresh Take on What a STEM Career Looks Like

Surprisingly STEM is a NASA video series that highlights exciting and unexpected jobs at NASA. Students learn about the broad range of careers behind the agency's missions – beyond the typical associations of rocket scientists and astronauts – and how each person's path to NASA is as unique as the job that they do. Students get to explore new career possibilities and learn what it takes to become a space tire engineer, a Moon rock processor, soft robotics engineer, and more. Educators can take the students deeper into the featured jobs with themed NASA hands-on lessons and activities paired with each episode.

The Season 1 videos that were released during FY 2023 on the NASA STEM YouTube channel, NASA social media accounts, and NASA+ – NASA's live broadcast television and video streaming app – have earned over 900,000 views. The success of Surprisingly STEM has sparked a spinoff series of live virtual classroom connections in which students from around the country can tune in to ask questions of the NASA experts featured in the videos. These virtual events kicked off in fall 2023 and Surprisingly STEM Season 2 launched in January 2024.

[Learn More](#) →

NASA Hosts Virtual Career Day for Students

NASA's Next Gen STEM project hosted a virtual Career Day on Sept. 28, 2023, providing students and educators nationally the opportunity to learn about a variety of STEM careers while also highlighting the important non-STEM careers that help support the agency's missions. Agency experts explained their unique jobs during question-and-answer sessions, and participants also explored virtual tours and experiences such as a NASA 65th Anniversary Hall of Fame, a career gallery, and an exhibit hall with additional information and resources.

Nearly 12,000 students and educators participated on the day of the event, and the resources remained available for 30 days for registrants who were unable to attend live.



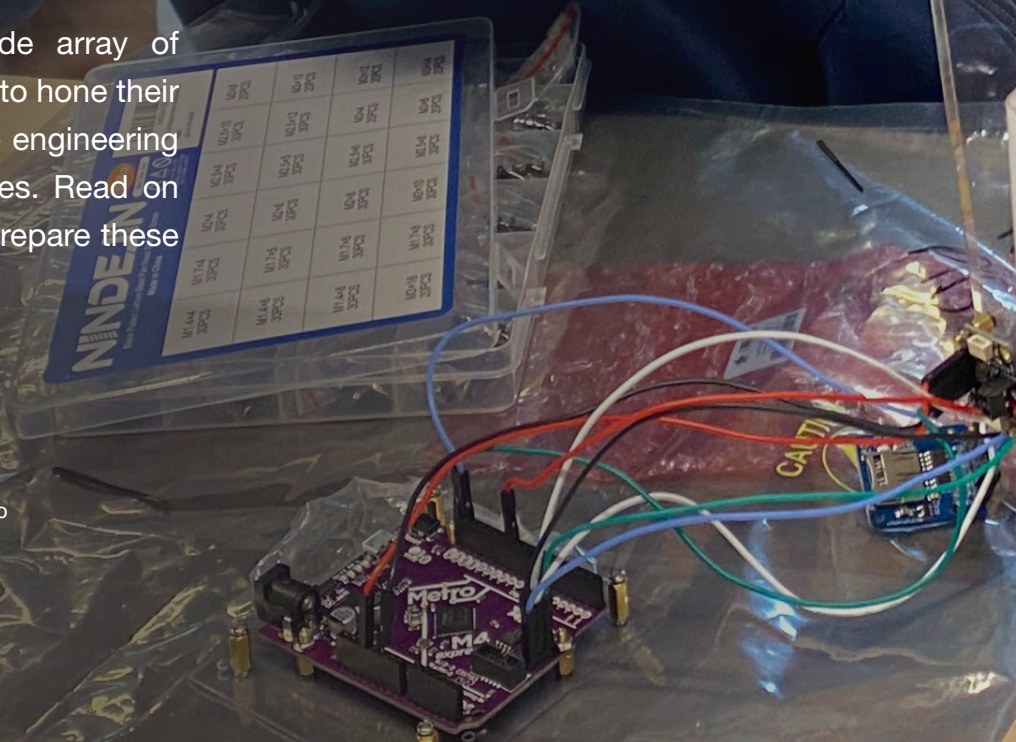
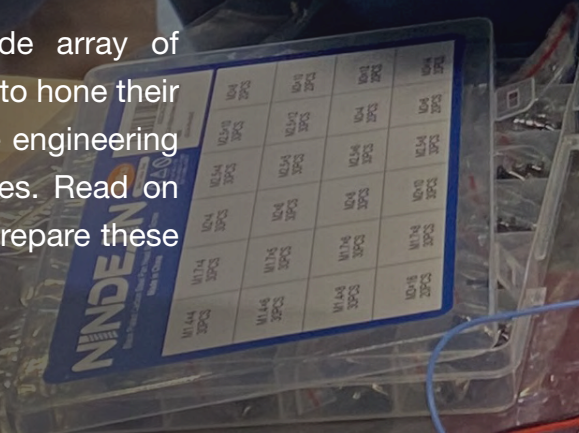
Preparing Tomorrow's STEM Workforce

NASA's Opportunities for Undergraduate and Graduate Students

The next exciting chapters in spaceflight and aviation are just beginning, and these endeavors require a talented workforce with strong STEM skills, bold ideas, and diverse perspectives. NASA STEM engagement efforts are helping to build this workforce atop a solid foundation of essential experiences for today's students. These opportunities enable students to engage directly with NASA experts, visit the agency's cutting-edge facilities, or even contribute directly to solving some of the complex technical challenges involved in the exploration missions to come.

Through NASA internships, fellowships, and a wide array of competitions and challenges, students get the chance to hone their STEM skills, gain first-hand experience in the iterative engineering process, and build confidence in their own capabilities. Read on to learn more about some of the ways NASA helped prepare these students in FY 2023.

The Herberger Young Scholars Academy team prepares their experiment for flight as part of the NASA TechRise Student Challenge. The experiment was designed to collect measurements of a solar panel's output as it makes its way further into the atmosphere. Students will analyze data retrieved from the flight. Credit: Herberger Young Scholars Academy



NASA intern Mackenzi Haub, a Pathways Intern at NASA's Johnson Space Center, stands in front of a NASA display case for the Space Shuttle Program and an astronaut suit. Credit: NASA



Internships

Students in high school through higher education gain out-of-this-world experience through NASA internships. As a part of the NASA team, each intern has a role in helping the agency reach its goals. Our interns gain valuable experience and practice hands-on skills in the workplace while working alongside agency professionals. Supportive NASA mentors help guide students to make the most of every internship. [Learn More](#) →

Meet some of our FY 2023 NASA interns and learn how they put their passions and skills to work at the agency.



Jenessa Stemke

Oregon State University
NASA Headquarters, Washington, D.C.

Jenessa Stemke worked as part of NASA's Wildland Fire Program, in which she assembled a matrix outlining the disconnects between the data science collection related to wildfires and the on-the-ground needs of wildfire experts. This research is helping to shape the way NASA supports wildfire initiatives.



Sheldon Scott

Prairie View A&M University
NASA Glenn Research Center, Cleveland, Ohio

Sheldon Scott explored ways to purify wastewater to be reusable on the lunar surface and even investigated ways to reuse "carbon products" extracted from the water for things like fuel. Sheldon's work supports the next giant leap of the Artemis Program – returning humans to the Moon.



Mike Fogg

American Military University
NASA Headquarters, Washington, D.C.

Mike Fogg joined NASA as an intern later in life than many agency interns, beginning his internship in his 40s after returning to school. His work focused on updating the NASA TechPort website, which archives past scientific work for future use—ensuring resources aren't spent repeating research that has already been completed.



Bosoon Karimi

University of Maryland Global Campus
Katherine Johnson Independent Verification and Validation (IV&V) Facility, Fairmont, West Virginia

Bosoon Karimi interned at Katherine Johnson Independent Verification and Validation (IV&V) Facility, where he helped to update enterprise-wide IT applications used to enable work at NASA. This work included migrating data and transitioning to new, cloud-supported systems that help the IV&V team collaborate and efficiently find the documents and references they need to support missions such as Orion and Gateway.

NASA GEM Fellow Asaad Abdul-Hamid speaks during the National GEM Consortium's Annual Board Meeting and Conference in Philadelphia, Pennsylvania, in September 2023. Asaad is a doctoral student in systems engineering at Stevens Institute of Technology in Hoboken, New Jersey. Credit: NASA



Fellowships

The NASA Fellowship Activity partners with the National GEM Consortium (GEM) to engage students from STEM graduate programs at Minority Serving Institutions in NASA research. Funded by MUREP, these opportunities enable fellows to contribute to NASA's work through research and innovation – further strengthening the experience and capabilities of incoming STEM professionals. [Learn More](#) →

Meet some of our outstanding NASA GEM Fellows and learn how their research is advancing the agency's scientific and technical capabilities.



Wilson Smith

Pursuing a master's in electrical engineering at Virginia Polytechnic Institute and State University

NASA Goddard Space Flight Center, Greenbelt, Maryland

"The project I assisted with involved researching different types of auroras and classifying these auroral events in real-time by analyzing hundreds of spectrograms, contributing to a better understanding of auroral events and their behavior. This research directly supports NASA's mission to explore and understand the Earth's magnetosphere and its interactions with solar wind, ultimately advancing our knowledge of space weather and its impact on our planet. Working with NASA's Office of STEM Engagement has provided me with exceptional opportunities to collaborate with leading scientists and contribute to cutting-edge research in space science."



Jose Perez Chavez

Pursuing a PhD in physics at Howard University

NASA Goddard Space Flight Center, Greenbelt, Maryland

"My research project involves studying wave-like perturbations near Mars' exosphere using a molecular gas kinetic simulation model. These waves, potentially caused by wind shears, convection, or topography, have been observed to heat the thermosphere-exosphere layers. Our aim is to understand how these upward-propagating waves deposit energy in the upper atmosphere of Mars and other bodies where similar waves have been observed, such as Titan. This research supports NASA's mission to explore and enhance our understanding of the solar system's workings. This experience has reinforced my aspiration to become a NASA scientist and contribute to the field of atmospheric studies of celestial bodies."



Kiara Burgos

Pursuing a master's in hydrology and elementary education at New Mexico Institute of Mining and Technology

NASA Goddard Space Flight Center, Greenbelt, Maryland

"In my time at NASA, I worked in Goddard's Planetary Geology, Geophysics, and Geochemistry Laboratory and focused on using orbital data collected by ICESat-2 to distinguish icy deposits from basalt morphologies on the surface. Lava tubes are also found on the Moon and Mars. My goal is to inspire and motivate a generation of students to immerse themselves in the world of geosciences, specifically students who come from similar backgrounds as myself. As an Afro-Latina, I was encouraged, inspired, and motivated by the people I worked with at Goddard. I hope to do the same. I want to continue to build on NASA's mission of building a more diverse workforce by sharing my story and conducting meaningful research."



Carter Fietek

Pursuing a PhD in mechanical engineering at The Ohio State University (Undergraduate degrees completed at New Mexico State University)

NASA Glenn Research Center, Cleveland, Ohio

"During my time at NASA Glenn, I worked on alloy development for additive manufacturing of propulsion components to be used on the Artemis Gateway. My research is concerned with material characterization and predicting mechanical performance of components based on material processing. Safety is of utmost importance to both the success of the mission and to the lives of the crew, so engineers must be able to predict the performance of their materials and parts. NASA has given me a unique opportunity to explore novel research and even publish findings very early on in my academic career. But most of all, NASA has provided me the opportunity to meet some of the world's brightest scientists and show me what a healthy and inclusive work environment can be!"

Escuela Secundaria de la Universidad de Puerto Rico's team tested a wearable radiation sensor made from an algae biomass as part of NASA's TechRise Challenge. They hope it could be used not only for future space applications but also to address marine algae overgrowth in Puerto Rico. Credit: Escuela Secundaria de la Universidad de Puerto Rico



NASA's Student Challenges

When students experience the creativity and problem-solving mindset of the iterative engineering process, they learn new skills and gain confidence in their capabilities that they'll carry for a lifetime. NASA's student challenges provide today's students with authentic opportunities to contribute their ideas and technological solutions to the agency's most pressing needs – all while investing in tomorrow's STEM workforce.

Fiscal year 2023 featured an array of challenges for students in middle school through higher education. Through these hands-on experiences, student teams devised new technologies for use at the Moon through the Artemis program, launched science payloads on sounding rockets and high-altitude balloons, designed and fabricated a new tool for astronauts aboard the International Space Station, innovated commercial uses for NASA technologies, and more.

Here are some of the highlights from this year's NASA's student challenges.



Student-Powered Rovers Return to In-Person Competition

Forty-eight teams of high school and college students put their rover design skills to the test during the Human Exploration Rover Challenge in April 2023. One of NASA's Artemis Student Challenges, the event marked the return of the on-site competition at the U.S. Space & Rocket Center in Huntsville, Alabama, for the first time since 2019. U.S. and international teams pedaled their rovers across an obstacle course to demonstrate traversing and completing tasks on terrain like the lunar surface.

[Learn More](#) →



Student-Built Rockets and Payloads Soar Above Alabama

More than 1,300 students from across the U.S. launched high-powered, amateur rockets near NASA's Marshall Space Flight Center in Huntsville, Alabama, as part of the culminating event for the agency's annual Student Launch challenge in April 2023. In this Artemis Student Challenge, teams of middle school, high school, and college-level students were tasked with designing and launching a rocket to an altitude between 4,000 and 6,000 feet, executing a mission with an onboard payload, and successfully landing.

[Learn More](#) →

Top: More than 500 students from around the world competed in NASA's 2023 Human Exploration Rover Challenge (HERC) in April 2023 at the Aviation Challenge camp of the U.S. Space & Rocket Center, near NASA's Marshall Space Flight Center in Huntsville, Alabama. Credit: NASA

Bottom: More than 1,300 students from across the U.S. and Puerto Rico launched nearly 50 high-powered, amateur rockets in April 2023 near NASA's Marshall Space Flight Center in Huntsville, Alabama, during the NASA's 2023 Student Launch competition. Credit: NASA

Top: Students from Chesterfield Career and Technical Center in Chesterfield, Virginia, calculate plant growth measurements and monitor environmental conditions for their basil plants for the Plant the Moon Challenge. Credit: NASA's Virginia Space Grant Consortia



Bottom: In June 2023 NASA's RockOn! and RockSat-C student flight participants pose in front of a Terrier-Improved Orion suborbital sounding rocket at NASA's Wallops Flight Facility, Wallops Island, Virginia. Credit: NASA

Teams 'Plant the Moon' With Plant-Growth Experiments

A total of 446 teams involving 4,483 students from five states and Puerto Rico gained hands-on experience in planetary science as they completed plant-growth experiments, part of the Plant the Moon Challenge Space Grant Regional Expansion Project. The students designed experiments to grow plants in a simulated lunar soil, known as regolith. Teams participated through a regional partnership of state Space Grant consortia led by the Virginia Space Grant Consortium and funded by NASA through the Space Grant K-12 Inclusiveness and Diversity in STEM (KIDS) opportunity.

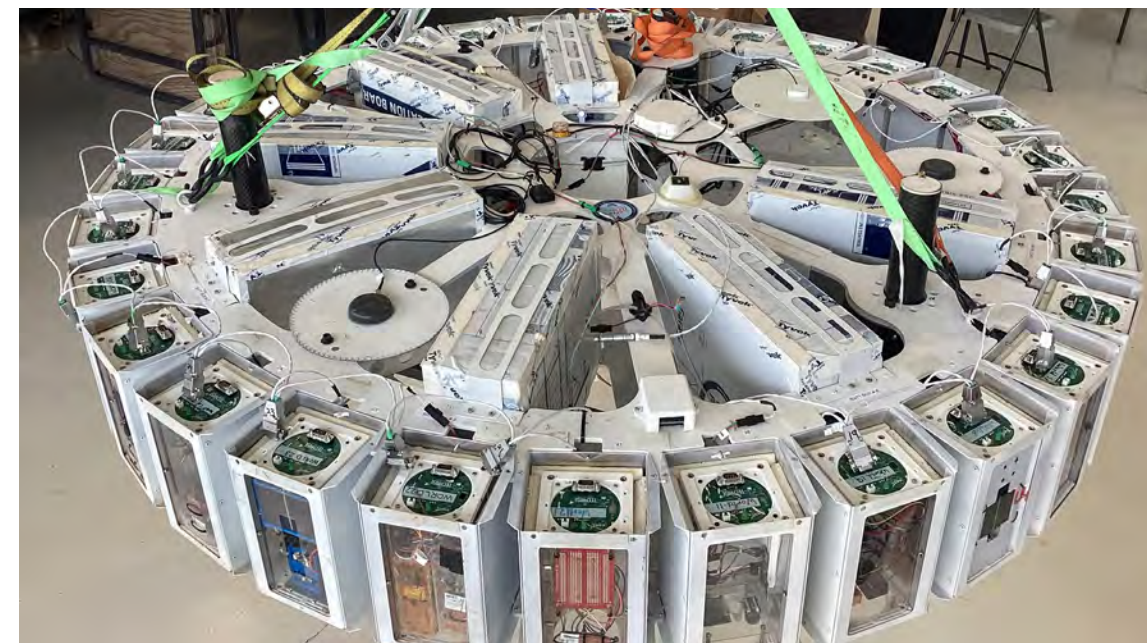
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Sounding Rockets 'RockOn!' With Student Payloads

Thirty-five experiments developed by 32 U.S. university and community college teams launched aboard a Terrier-Improved Orion sounding rocket through the RockOn! student flight opportunity. The August 2023 launch carrying the students' experiments reached an altitude of 73 miles (116.6 kilometers), then splashed down under parachute in the Atlantic Ocean. All of the student teams received their flown experiment and data for analysis. RockOn! teams hailed from 20 states; half the teams represented Minority Serving Institutions.

[Learn More](#) →



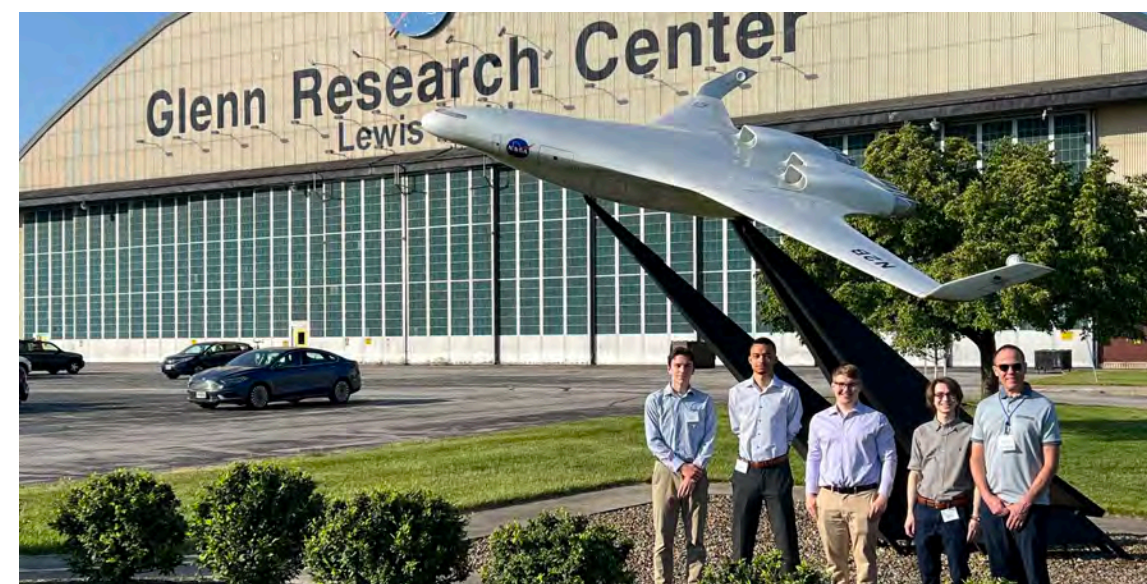
Top: These 30 experiments, housed in a World View zero-pressure balloon gondola flew in the stratosphere above Page, Arizona, for more than four hours on July 24, 2023, as part of the NASA TechRise Student Challenge. Credit: NASA

Bottom: Students at Glenn Research Center in Cleveland, Ohio, during the Blue Skies Forum in June 2023. Credit: NASA

NASA TechRise Student Teams Take Flight

Students from across the country saw their work take flight in 2023 with NASA's TechRise Student Challenge, managed by NASA's Flight Opportunities program within the agency's Space Technology Mission Directorate (STMD). Eighty middle and high school teams tested their science and technology experiments through three suborbital flight tests on commercial high-altitude balloons with Aerostar and World View. Projects flew for over four hours at over 70,000 feet during each flight test, enabling students to gather data from experiments in a variety of technical areas, including radiation sensing, solar panel development, and the measurement of greenhouse gases.

[Learn More](#) →



'Blue Skies' Teams Focus on Climate-Friendly Aviation

In the push towards climate-friendly aviation and emerging aviation markets, collegiate students in the 2023 Gateways to Blue Skies competition investigated alternate energy sources that, if developed further, could be a solution to climate impacts due to aviation. Eight teams from seven different institutions were chosen to present their findings in a competitive design review during the Blue Skies Forum at NASA's Glenn Research Center in Cleveland in June 2023. Blue Skies is sponsored by NASA's University Innovation Project within the Aeronautics Research Mission Directorate. It is managed by the National Institute of Aerospace.

[Learn More](#) →

Top: Colorado School of Mines team members pour regolith slag into tile sandcasting molds to review applicability for use as building products in the 2023 BIG Idea Challenge. Credit: Colorado School of Mines



Bottom: Ball Clamp Monopods packaged for transport to the International Space Station. Students designed these devices to keep cameras stable while tracking targets on the ground or taking images and video inside the space station. Credit: NASA

BIG Ideas for Lunar Exploration

Through its 2023 Breakthrough, Innovative and Game-Changing (BIG) Idea Challenge, NASA awarded nearly \$1.1 million to seven university teams for innovative concepts to forge metals from lunar minerals to create structures and tools on the Moon. The year-and-a-half-long challenge, funded by NASA's STMD and OSTEM, supports STMD's work developing new approaches and novel technologies critical for successful exploration on the lunar surface. In August 2023, BIG Idea Challenge finalist teams were invited to present their concepts at the Lunar Surface Innovation Consortium's (LSIC) fall workshop focusing on in-situ resource utilization. LSIC operates in collaboration with NASA's STMD under the Lunar Surface Innovation Initiative. In November, the seven finalist teams representing approximately 108 undergraduate and graduate students, presented their research, designs, prototypes, and testing results to a panel of NASA and industry judges at the culminating forum in Cleveland, Ohio.

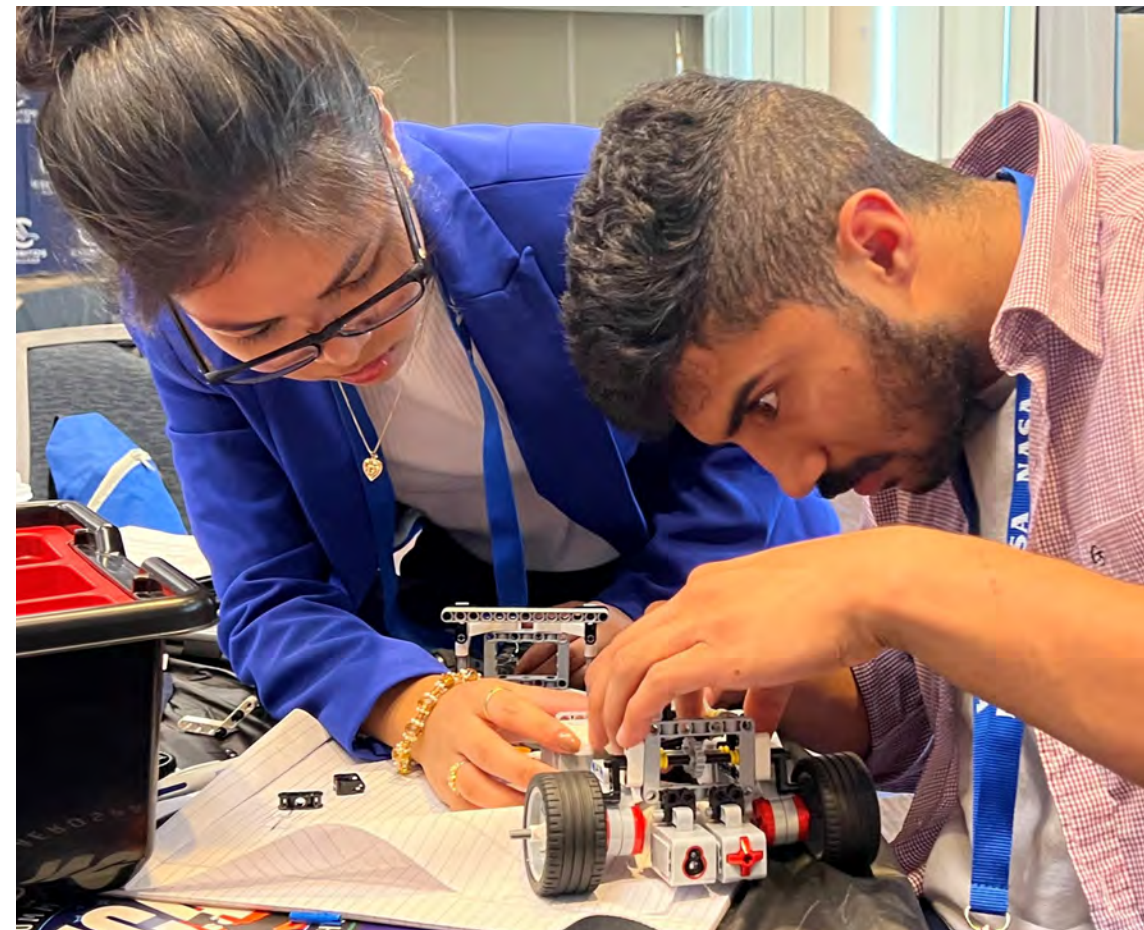
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Student Innovation for Stable Images

The High Schools United with NASA to Create Hardware (HUNCH) program enables students to fabricate real-world products for NASA. The HUNCH Ball Clamp Monopod flew to the International Space Station in 2023 to test a platform to keep cameras stable while tracking targets on the ground or taking images and video inside the space station. Students from Cypress Woods High School in Cypress, Texas, Clear Creek High School in League City, Texas, and Conroe High School in Conroe, Texas, participated in the project.

[Learn More](#) →



Top: NCAS participants work on their rovers at the Mission 3: Innovate Robotics Competition at Orange Coast College in Costa Mesa, California. Credit: NASA

Bottom: Teams make final preparations ahead of launching their rockets during the 14th First Nations Launch High-Power Rocket Competition at the Richard Bong State Recreational Area in Wisconsin. One of NASA's Artemis Student Challenges, the agency's Wisconsin Space Grant Consortium facilitated the competition, which was hosted in April 2023 by Carthage College in Kenosha, Wisconsin. Credits: Steve Janiak/Wisconsin Space Grant Consortium

NASA Community College Aerospace Scholars

Community college students gain new knowledge and vital skills through authentic, experiential learning opportunities through NASA Community College Aerospace Scholars (NCAS). NCAS has three missions designed to challenge and build student knowledge and skills by focusing on NASA's mission goals, collaboration, and career pathways. In FY 2023, 1,144 students, 96.4% of whom are attending Minority Serving Institutions, participated in NCAS. Attendees represented 40 U.S. states plus the District of Columbia and Puerto Rico. Additionally, 10 NCAS alumni were granted MUREP-funded internships.

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First Nations Launch Competition

Throughout the months of NASA's First Nations Launch competition, teams of undergraduate students experienced the engineering design process to design, build, and fly high-powered rockets. In April 2023, 119 students representing Tribal Colleges and Universities (TCU), Native American-Serving Nontribal Institutions (NASNTI), and American Indian Science and Engineering Society (AISES) chapters gathered at Carthage College in Kenosha, Wisconsin, for the competitions culminating event. First Nations Launch is an Artemis Student Challenge funded by NASA's Minority University Research and Education Project (MUREP) and facilitated by the Wisconsin Space Grant Consortium.

[Learn More](#) →



Top: NASA MINDS and First Nations Launch winning teams visited the iconic Vehicle Assembly Building during their VIP experience at Kennedy Space Center.
Credit: NASA



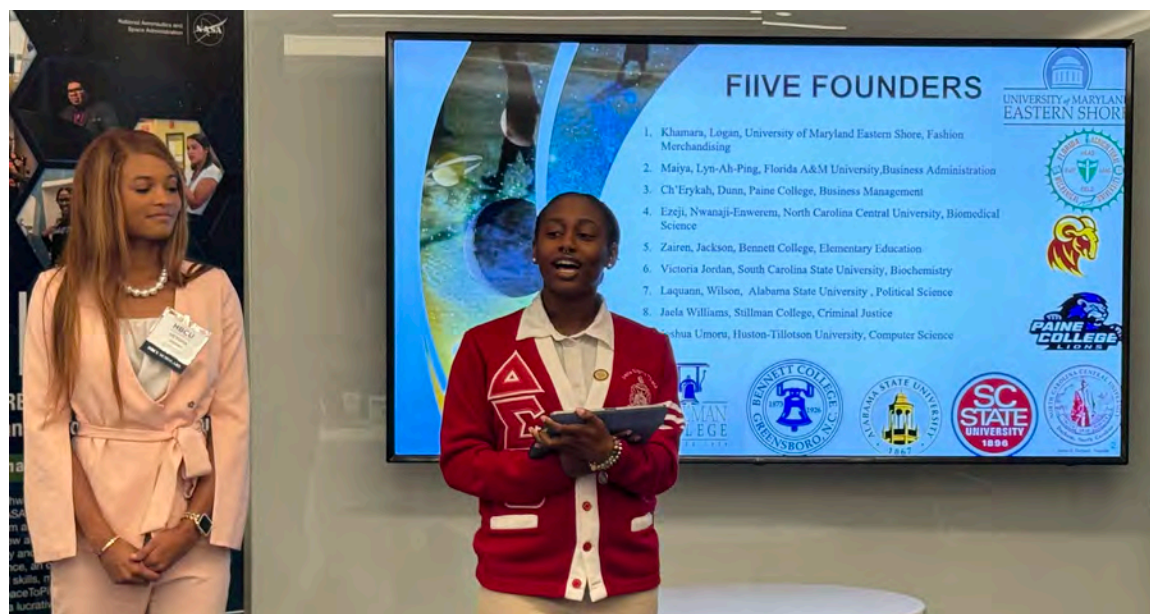
Bottom: Jaela Williams of Stillman College presents for Team Five – called FIIVE – during the pitch portion of the MITTIC HBCU Hackathon and Pitch Competition.
Credit: NASA

Opposite: Student team members test their augmented reality device at NASA's Johnson Space Center in Houston in May 2023. This activity, which took place at the center's Rockyard, was part of the culminating event of the NASA Spacesuit User Interface Technologies for Students (NASA SUITS) challenge. Credit: NASA

NASA MUREP Innovative New Designs for Space (NASA MINDS)

Thirty-nine teams representing 34 Minority Serving Institutions (MSI) from 14 states completed the 2023 NASA MUREP Innovative New Designs for Space (NASA MINDS). Through this undergraduate-level challenge, NASA provides funds to MSI student and faculty teams to design and build technology prototypes for potential use in the Artemis program. Former NASA astronaut Winston Scott presented awards during a virtual ceremony May 12, 2023, and the top two winning teams earned a VIP experience at NASA's Kennedy Space Center in Florida.

[Learn More](#) →



MITTIC HBCU Hackathon and Pitch Competition

In September 2023, the NASA MUREP Innovation and Tech Transfer Idea Competition (MITTIC) partnered with the White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity for Historically Black Colleges and Universities (HBCU) to provide the Initiative's scholars an authentic NASA experience: the MITTIC HBCU Hackathon and Pitch Competition. In this condensed version of the full NASA MITTIC competition, teams selected a NASA intellectual property (IP), then developed and pitched an idea to commercialize that IP to improve life on HBCU campuses. The scholars visited NASA's Goddard Space Flight Center for the HBCU Hackathon as well as a tour.

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Bolstering America's Aerospace Capabilities

Supporting Research and Infrastructure at U.S. Colleges and Universities

Every year, NASA funds critical scientific and technological research that not only aligns with the agency's missions and priorities, but also helps to build academic institutions' curriculum, programming, and infrastructure for future research capacity. By investing in today's national STEM ecosystem, NASA is ensuring tomorrow's scientists and engineers are prepared for the exciting space and aviation challenges that lie ahead.

Several NASA organizations participate in the selection and funding of these innovative projects. These include 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 agency's mission directorates. Here are some of the ways NASA funded cutting-edge research and supported future efforts in FY 2023.

Madeleine Rea collects snow surface samples for the snow algae resurfacing experiment on the Harding Icefield in Alaska. Rea, a graduate student at Alaska Pacific University, is studying the seasonal red snow algae reappearance on the icefield with support from the Alaska Space Grant Program. Credit: Madeleine Rea



Highlighting NASA's FY 2023 Investments in STEM

MUREP DEAP

Feb. 3, 2023
\$11.7 Million

NASA awarded funds to eight Historically Black Colleges and Universities (HBCUs) through the new MUREP Data Science Equity, Access, and Priority in Research and Education (DEAP) opportunity. This award, in collaboration with the Science Mission Directorate, enables HBCU students and faculty to conduct innovative data science research that contributes to NASA's missions.

[Learn More](#) →

MUREP WCU

June 7, 2023
\$5 Million

NASA awarded more than \$5 million in funding to seven Women's Colleges and Universities (WCUs) to research and develop strategies that increase retention of women in STEM degree programs and careers. Part of a Biden/Harris initiative, NASA MUREP created this opportunity to help women overcome obstacles and barriers to working in STEM fields. [Learn More](#) →

EPSCoR ISS Flight Opportunity

July 26, 2023
\$500,000

The International Space Station Flight Opportunity provides a ride to low Earth orbit for mature, flight-ready research projects. This opportunity entails cooperation with NASA's International Space Station Research Office, mission directorates, and field centers. NASA selected five institutions to receive \$100,000 each – \$500,000, total – to complete their projects.

[Learn More](#) →

M-STAR

July 26, 2023
\$8 Million

The MUREP Space Technology Artemis Research (M-STAR) opportunity supports NASA's Space Technology Mission Directorate (STMD) by fostering and increasing Minority Serving Institutions' participation in research and technology development concepts relevant to the agency's needs for upcoming Artemis missions to the Moon. The agency awarded nine institutions a total of more than \$8 million.

[Learn More](#) →

EPSCoR RII

Sept. 11, 2023
\$600,000

Ten research investigators at nine academic institutions will advance their science and technology projects while contributing to NASA's research priorities through an agency collaboration with the U.S. National Science Foundation (NSF). NSF is providing \$2.7 million in funding through its EPSCoR Research Infrastructure Improvement (RII) program and NASA is providing \$600,000 in funding through its EPSCoR project.

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EPSCoR Research Opportunity

March 20, 2023
\$10.8 Million

NASA provided a total of more than \$10.8 million across 15 institutions over three years to support scientific and technical research. Each grantee will focus on a range of high-priority research needs, including deep space exploration, sustainable manufacturing in space, and advancements in technology and science that will also benefit humanity here on Earth.

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EPSCoR R3

June 23, 2023
\$4 Million

Through its 2023 Rapid Response Research (R3) grants, NASA EPSCoR provided nearly \$4 million in total funding to support research aligning with the agency's strategic priorities. These grants are a vital component of NASA's STEM strategy to foster collaboration and stimulate growth in research and development in underserved areas nationwide.

[Learn More](#) →

MUREP Curriculum

July 26, 2023
\$6 Million

The MUREP Curriculum Award was established in FY 2023 to help Minority Serving Institutions strengthen their STEM academic offerings. NASA awarded five institutions a total of nearly \$6 million to implement projects designed to boost awardee institutions' curriculums.

[Learn More](#) →

M-PLAN

Aug. 1, 2023
\$900,000

Students and faculty at 15 Minority Serving Institutions will grow their research and technology capabilities, collaborate with NASA on research projects, and contribute to the agency's missions through MUREP Partnership Learning Annual Notification (M-PLAN). These funds help awardees develop new technologies for use in space exploration as well as in the commercial marketplace.

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RESEARCH & TECHNOLOGY SPOTLIGHT



OSTEM Contributes to New Innovation Featured in 2023 NASA Spinoff

A bioreactor developed with the goal of growing protein in space as a potential food source for astronauts is being adapted to generate quality proteins in under-resourced communities in Africa and Asia. The bioreactor and starter microbe were flown to the International Space Station with help from a grant from NASA EPSCoR awarded to the project's developer Nature's Fynd and BioServe Space Technologies.

Astronaut Jessica Watkins holds a Nature's Fynd bioreactor on the International Space Station. The device successfully produced Fy protein in microgravity, making it a possible food source for long missions. Credits: NASA



Broadening STEM Participation Through Partnerships

Collaborating With Partners to Inspire Students

NASA fosters an array of partnerships that connect students from across the nation with the agency's most exciting endeavors. These efforts reach a wide range of students, from pre-kindergartners through university undergraduates, including students from groups and communities underrepresented in STEM. Through partnerships between industry and NASA's experts and resources, these agreements forge connections to the agency's missions, STEM careers, and more.

In FY 2023, NASA supported 23 active national partnerships in the area of student STEM engagement via Space Act Agreements or Memoranda of Understanding. This work resulted in over 7 million digital engagements, including video views and product interactions.

D.C. area students participate in a Minecraft Artemis demonstration during Space Education Day in June 2023 at the Microsoft Technology Center in Arlington, Virginia. Microsoft hosted the event to showcase the collaboration, early successes, and future plans for high quality student engagement through activities that combined space content and technologies like artificial intelligence and cloud computing. Credit: NASA

Partnership Highlights in FY 2023

Top left: This graphic includes the logo for NASA's live webinar, "Eclipse Through the Eyes of NASA." Credit: NASA



Top right: NASA astronaut Tom Marshburn recorded the reading of "Goodnight Moon" during his expedition aboard the International Space Station. Credit: NASA



NASA HOSTS WEBINAR FOCUSING ON UPCOMING SOLAR ECLIPSES

Prior to the two solar eclipses experienced in areas throughout the U.S., 220 participants attended NASA's live webinar, "Eclipse Through the Eyes of NASA," on July 25, 2023. The event explored the science of eclipses, safety, opportunities to connect these events to NASA missions, key messages, engagement plans, and more.

CELEBRATING EARTH DAY WITH CRAYOLA

In a collaborative virtual Earth Day event about 20,000 people tuned in to learn how NASA uses information gathered on Earth and in space to take care of our planet, and how the agency shares this information through visualizations and storytelling. Then, a Crayola specialist led viewers through an art demonstration inspired by data visualization.

Bottom left: This artist's illustration shows a gas giant planet circling a pair of red dwarf stars. Credit: NASA



Bottom right: A Minecraft version of NASA's Space Launch System rocket stands ready to launch on a mission to the Moon in this screenshot from Minecraft Artemis Missions. Credit: Minecraft

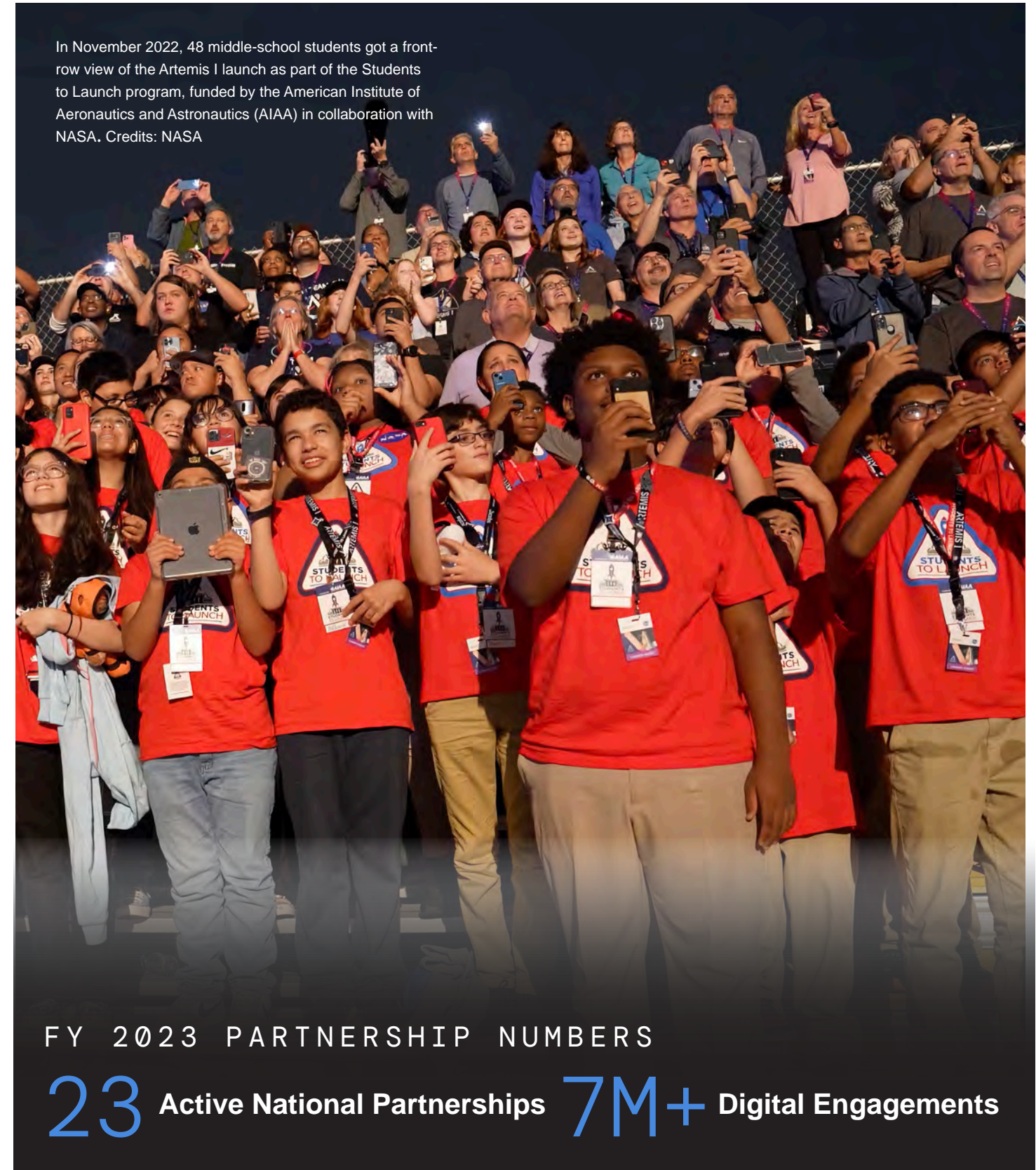


INTRODUCING STUDENTS TO EXOPLANETS WITH GOOGLE APPLIED DIGITAL SKILLS

NASA and Google collaborated to release online instructional materials to introduce students to STEM concepts and careers. Materials include instructional and student videos, lesson plans, and supporting information designed to help students learn about the science and technology behind exoplanet discovery. The activity culminates with students developing a travel brochure highlighting key features of an exoplanet based on their research.

BUILDING THE ARTEMIS MISSION WITH NASA AND MINECRAFT

Kids can build and launch a rocket and blast off on an adventure to the Moon through an Artemis-inspired set of worlds, developed through a partnership between Minecraft Education and NASA. Millions of students have interacted with the Minecraft Artemis Missions, which were developed to engage students in NASA's next chapter in human spaceflight and encourage them to see themselves as future astronauts or scientists.



In November 2022, 48 middle-school students got a front-row view of the Artemis I launch as part of the Students to Launch program, funded by the American Institute of Aeronautics and Astronautics (AIAA) in collaboration with NASA. Credits: NASA

FY 2023 PARTNERSHIP NUMBERS

23 Active National Partnerships **7M+** Digital Engagements

Stay Connected

Find official NASA social media accounts and follow us on our mission of exploration and discovery



Learn more about NASA STEM Engagement efforts and opportunities at stem.nasa.gov.



Keep up with the latest NASA STEM events and opportunities by subscribing to the [NASA EXPRESS e-newsletter](#). Each weekly email features activities to inspire learning and exploration, as well as updates on workshops, internships, contests, and student challenges.



For more NASA STEM inspiration, follow NASA STEM on social media!

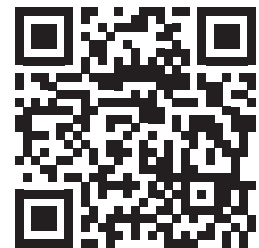


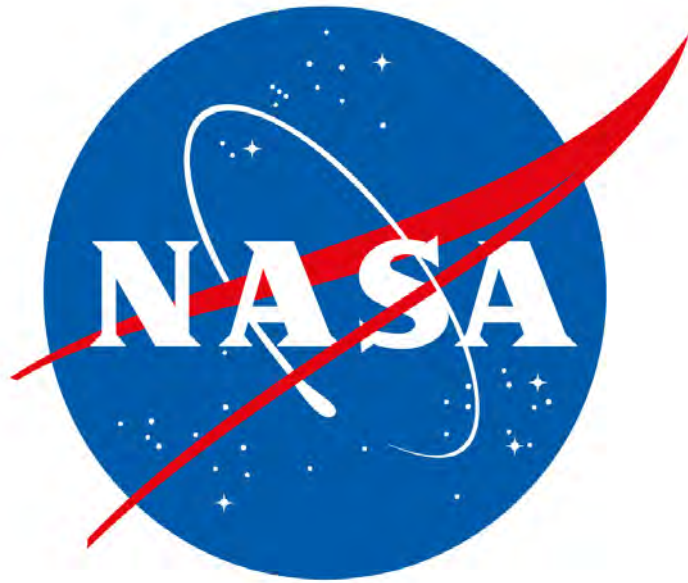
NASA STEM Gateway: Discover Your Next Giant Leap

Your gateway to explore NASA experiences designed to
INSPIRE • ENGAGE • EDUCATE • EMPLOY
the next generation of explorers

The NASA STEM Gateway is your portal to discover current available opportunities in the areas of internships, challenges, research, educator professional development, and STEM experiences for pre-college and college students. Explore STEM experiences designed to inspire, engage, educate, and employ the Artemis Generation, then apply for the experience that's right for you.

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