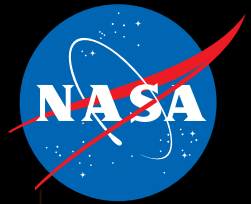


National Aeronautics and  
Space Administration



# MARSHALL SPACE FLIGHT CENTER

MARSHALL STAR 2022 YEAR IN REVIEW

01 | 11 | 2023

# DIRECTOR'S CORNER

## Artemis I Mission Highlights Historic Year

This year we accomplished so much at Marshall Space Flight Center, working with our commercial partners on some of NASA's most exciting missions. Along with the historic Artemis I mission, there were so many other agency milestones that wouldn't have been possible without the unique skills, knowledge, resources, and infrastructure only found at our center. Whether it's developing the habitation and life support systems to live and work in space or advancing the technologies that will allow us to travel to deep space destinations, everything we've accomplished this year is because of you.

That was on full display last month with the successful splashdown of the Orion capsule in the Pacific Ocean, concluding the Artemis I mission – one our center played a pivotal part in. From manufacturing and testing the Space Launch System rocket to supporting it through this flight and beyond, I am so proud of our center's contributions to this historic achievement in our nation's space program.

While I want you to pause and reflect on all that we have achieved with Artemis I, we have teams already building rockets and working on the technology and hardware needed for later missions that will land the first woman and the first person of color on the surface of the Moon. Sustainable lunar exploration will require the best of our talented workforce, and I know you are already hard at work developing the technologies needed to make that a reality.

Look at what we've achieved over the past calendar year. The Imaging X-Ray Polarimetry Explorer and the James Webb Space Telescope are already changing how we view the universe; and in low-Earth orbit, teams at the Payload Operations Integration Center continued to support science on the International Space Station as they have for more than two decades. As we look at the agency's future architecture, we know Marshall will be a critical part of the autonomous and human-tended payload operations that will sustain Artemis missions.

Also in low-Earth orbit, our center continued its support of the Commercial Crew Program's successful SpaceX Crew-3, Crew-4 and Crew-5 missions in 2022. We also assisted in the successful Orbital Flight Test-2 of Boeing's Starliner vehicle in May and will again be working with our commercial partners on Starliner's first crew flight test as well as the SpaceX Crew-6 launch – both scheduled for early 2023.

This year, we also laid the foundation for future human landing systems with agreements in place for the initial landing systems that will take astronauts to the Moon for Artemis III and IV, while also looking to the future with a Sustaining Lunar Development contract that will ensure NASA can reach the long-term goal of continuous missions.

In November, we hosted agency leadership for a Town Hall where they discussed a blueprint for sustained human presence and exploration throughout the solar system, and I'm proud to say our center continues to align our capabilities with the architectures and technology gaps needed to achieve the agency's Moon to Mars objectives.

It was a year of historical accomplishments, but also historical change – both in how we work and where we work. Those changes include the demolition of Buildings 4201 and 4200, Marshall's administrative headquarters for 63 years. The demolition of 4200 closed a big chapter of our history, but it also clears the way for new infrastructure that will take us into the next era of deep space exploration – one that Marshall will continue to play a critical role in. We're excited to look ahead to the facilities and resources we need to chart the next 60 years and beyond.

We celebrated several Apollo anniversaries over the past year, and I'd like to think history will look back on all that you have and will accomplish for the Artemis missions with the same reverence and admiration we share for the team that sent astronauts to the Moon for the first time more than 50 years ago.

As busy as this year was, we aren't slowing down and have so many amazing things to look forward to in 2023. Let's have an outstanding year and keep the momentum going!



**Jody Singer, Director**  
Marshall Space Flight Center





# JANUARY

## New IXPE Mission Begins Science Operations

NASA's newest X-ray eyes are open and ready for discovery. Having spent just over a month in space, the [Imaging X-ray Polarimetry Explorer](#) (IXPE) started zeroing in on some of the hottest, most energetic objects in the universe. A joint effort between NASA and the Italian Space Agency, IXPE is the first space observatory dedicated to studying the polarization of X-rays coming from objects like exploded stars and black holes. Polarization describes how the X-ray light is oriented as it travels through space. "The start of IXPE's science observations marks a new chapter for X-ray astronomy," said Martin Weisskopf, then the mission's principal investigator at NASA's Marshall Space Flight Center. "One thing is certain: We can expect the unexpected."

## Marshall Leaders Share Insights

Throughout 2022, Marshall managers shared their insights on leadership, inspiration, mentorship, and more, in the monthly Take 5 profile series. The Marshall Star interviewed leaders from the Office of Strategic Analysis & Communications, NASA's Michoud Assembly Facility, Science and Technology Office, Space Systems Department, Technology Demonstration Missions, Commercial Crew Program, Human Exploration Development & Operations Office, Space Launch System Program, Planetary Missions Program Office, Habitation Systems Development Office, Exploration Transportation and Development Office, and Telecommunications Services.

## NASA Prepares SLS Moon Rockets for First Crewed Artemis Missions

As teams continued to prepare NASA's [Space Launch System](#) (SLS) rocket for its debut flight with the launch of Artemis I, NASA and its partners across the country made great progress building the rocket for Artemis II, the first crewed Artemis mission. The team is also manufacturing and testing major parts for Artemis missions III, IV, and V.

"The Space Launch System team is not just building one rocket but manufacturing several rockets for exploration missions and future SLS flights beyond the initial Artemis launch," said John Honeycutt, SLS program manager at Marshall. "The Artemis I mission is the first in a series of increasingly complex missions that will extend our presence on the Moon. The SLS rocket's unprecedented power and capabilities will send missions farther and faster throughout the solar system."

## IXPE Sends First Science Image

In time for Valentine's Day, NASA's Imaging X-Ray Polarimetry Explorer delivered its first imaging data since completing its month-long commissioning phase. All instruments functioning well aboard the observatory, which is on a quest to study some of the most mysterious and extreme objects in the universe. IXPE first focused its X-ray eyes on Cassiopeia A, an object consisting of the remains of a star that exploded in the 17th century. The shock waves from the explosion swept up surrounding gas, heating it to high temperatures and accelerating cosmic ray particles to make a cloud that glows in X-ray light. Other telescopes have studied Cassiopeia A before, but IXPE will allow researchers to examine it in a new way.

## NASA Selects Developer for Rocket to Retrieve First Samples from Mars

NASA awarded a contract to Lockheed Martin Space of Littleton, Colorado, to build the Mars Ascent Vehicle (MAV), a small, lightweight rocket to launch rock, sediment, and atmospheric samples from the surface of the Red Planet. The award brings NASA a step closer to the first robotic round trip to bring samples safely to Earth through the [Mars Sample Return Program](#). "This groundbreaking endeavor is destined to inspire the world when the first robotic round-trip mission retrieves a sample from another planet – a significant step that will ultimately help send the first astronauts to Mars," NASA Administrator Bill Nelson said. Marshall is responsible for overall management of the MAV as the agency continues to build on a history of successful industry partnerships for planetary missions.

# FEBRUARY



## Enough Space: Marshall Couples Balance Home, Work Relationships

Combining love and a NASA career may not be rocket science, but it does require finding enough space to balance work and home life. Necessary cargo for a journey toward a healthy relationship also includes patience, flexibility, and the ability to laugh. Many couples at Marshall are on this mission together. Three of the couples were profiled in 2022: Dayna and Carl Ise, Denise and Kenneth Smithers, and Huu and Diep Trinh ([Pictured](#)). The Ises and Smithers met at Marshall, while the Trinhns went to school together in Vietnam before being reunited at a refugee camp. With Valentine's Day in sight, the couples talked with the Marshall Star about how they've sustained an enduring relationship while also working together.

## NASA's Spinoff Publication Highlights Marshall Technology

Products and services that benefit life on Earth put a new spin on technology developed for space. NASA engineers and scientists often develop new technology during the course of their mission work. And while the origin of the technology is often to help explore the solar system and beyond, NASA's Technology Transfer program is bringing them back down to Earth by licensing them to companies and entrepreneurs. The licensees then create new products and services, called "spinoffs," that benefit the economy, protect the environment, and even save lives. NASA's Technology Transfer program has over 1,200 technologies available for licensing. The 2022 edition of NASA's [Spinoff](#) publication highlighted two examples of technology available for licensing from Marshall – a more rugged infrared camera and a process for making stronger, less polluting concrete.

## NASA Provides Update to Astronaut Moon Lander Plans Under Artemis

As NASA makes strides to return humans to the lunar surface under Artemis, the agency announced plans March 23 to create additional opportunities for commercial companies to develop an astronaut Moon lander. Under this new approach, NASA is asking American companies to propose lander concepts capable of ferrying astronauts between lunar orbit and the lunar surface for missions beyond Artemis III, which will land the first astronauts on the Moon in more than 50 years. Built and operated according to NASA's long-term requirements at the Moon, new landers will have the capability to dock to a lunar orbiting space station known as [Gateway](#), increase crew capacity, and transport more science and technology to the surface.

## NASA'S MEGA MOON ROCKET, SPACECRAFT COMPLETE FIRST ROLL TO LAUNCH PAD

NASA's Space Launch System (SLS) rocket with the [Orion](#) spacecraft atop arrived at Launch Pad 39B at the agency's Kennedy Space Center on March 18 in preparation for a final test before its [Artemis I](#) Moon mission. Stacked on the mobile launcher and mounted on the crawler-transporter for a journey from the Vehicle Assembly Building to Launch Pad 39B, it took 10 hours and 28 minutes for SLS and Orion to reach the launch pad four miles away. Marshall manages the SLS Program. Marshall teams designed, developed, built, and tested hardware for the rocket. SLS and NASA's Orion spacecraft, along with the human landing system and the Gateway in orbit around the Moon, are NASA's foundation for deep space exploration.



# MARCH



## Student Rockets Return to Alabama Skies

Following two years of virtual events, high school and college teams from across the country returned to Bragg Farms in Toney, Alabama, to compete in NASA's [Student Launch](#) rocketry competition April 23. Sixty teams from 22 states including Puerto Rico took part in this year's competition, with 27 teams launching at Bragg Farms. Winners were announced in a virtual ceremony June 2. For the second year in a row, The University of North Carolina at Charlotte won the launch division, while Tarleton State University in Stephenville, Texas, won first place in the design division. Each year, NASA challenges students from across the United States to design, build and launch a high-powered amateur rocket, fly it to an altitude between 4,000 and 6,000 feet, and make a successful landing.

# APRIL

04

## Paul Gradl Named AIAA's Engineer of the Year

Paul Gradl, a principal engineer at Marshall, received a 2022 Premier Award for Engineer of the Year from the American Institute of Aeronautics and Astronautics, or AIAA, during its awards gala, held April 27 in Washington, D.C. Gradl was recognized by the institute for his exceptional engineering and innovation, developing metal additive manufacturing techniques to meet NASA missions and industry needs. Gradl has led several projects across NASA for the additive manufacturing of liquid rocket engine combustion devices and supported a variety of development and flight programs for over 18 years. He has also championed and contributed to the agency's Rapid and Analysis Manufacturing Propulsion Technology project, or RAMPT, helping to advance manufacturing methods, such as 3D printing.

## NASA Announces Winners of 2022 Human Exploration Rover Challenge

NASA recognized a new generation of potential space explorers who competed in the agency's 28th annual [Human Exploration Rover Challenge](#). High school and college students from around the U.S. and world have spent the last eight months designing, building, and testing their rovers for the challenge – one of the original seven NASA [Artemis Student Challenges](#). NASA announced the winners during a [virtual awards ceremony](#) April 29. The challenge involved 91 teams, including 58 colleges and 33 high schools. HERC tasked U.S. and international student teams with designing, engineering, and testing a human-powered rover on a course simulating terrain found on rocky bodies in the solar system. Teams also performed mission assignments while negotiating the course, including sample retrievals and spectrographic analysis.

# Starliner Launches to Space Station with Help from Marshall Engineers

Boeing's CST-100 Starliner launched on a United Launch Alliance Atlas V rocket to the International Space Station on May 19. The mission tested the end-to-end capabilities of the crew-capable system as part of NASA's [Commercial Crew Program](#). Starliner lifted off on NASA's Boeing Orbital Flight Test-2 (OFT-2) from Space Launch Complex-41 at Cape Canaveral Space Force Station in Florida. Following an orbital insertion burn 31 minutes later, Starliner was on its way for a rendezvous and docking with the space station. NASA's Commercial Crew Program launch vehicle on-console mission support team in the Huntsville Operations Support Center at Marshall monitored the health of the rocket during countdown for the launch of OFT-2.



# MAY

## Mission Success is in Our Hands Series

The goal of the Mission Success is in Our Hands video lecture series is to help team members make meaningful connections between their jobs and the safety and success of NASA and Marshall missions through shared experiences discussions, awards, and recognition. Guest speakers echoed that theme throughout the series in 2022. Those delivering presentations included NASA astronaut Nicole Mann; James Webb Space Telescope Director Gregory Robinson; Steve Arnette, a senior vice president in Jacobs' Critical Mission Solutions; and former NASA astronaut Jan Davis. The series also includes a presentation of the Golden Eagle Award, which promotes awareness and appreciation for flight safety, as demonstrated through the connections between employees' everyday work, the success of NASA and Marshall's missions, and the safety of NASA astronauts.

## NASA Extends Exploration for 8 Planetary Science Missions

Following a thorough evaluation, NASA extended the planetary science missions of eight of its spacecraft due to their scientific productivity and potential to deepen knowledge and understanding of the solar system and beyond. The selections include four missions managed by programs in the Planetary Missions Programs Office at Marshall: Lunar Reconnaissance Orbiter and InSight from the Discovery Program, and New Horizons and OSIRIS-REx from the New Frontiers Program. Also selected were Mars Odyssey, Mars Reconnaissance Orbiter, MAVEN, and Mars Science Laboratory (Curiosity rover). The missions will continue assuming their spacecraft remain healthy. Most of the missions will be extended for three years; however, OSIRIS-REx will be continued for nine years in order to reach a new destination, and InSight continued until the end of 2022.

## NASA EXPRESS Racks Achieve 1 Million Hours of Service on Space Station

NASA science research on the [International Space Station](#) reached an extraordinary milestone June 14. The vital, versatile [EXPRESS Racks](#) – properly known as “EXpedite the Processing of Experiments to the Space Station” multipurpose payload shelving units – logged 1 million hours of combined powered duty on station. That’s the equivalent of nearly 115 years’ worth of scientific research completed in just two decades. The 12 permanent racks collectively support as many as 100 experiments at a time, enabling a wide variety of scientific research with practical benefits on Earth and for the Artemis explorers NASA soon will send back to the Moon and eventually to Mars. Experiments in the racks are controlled by station crew or remotely by specialized NASA team members in Marshall’s [Payload Operations Integration Center](#).

# JUNE

## NASA Completes Wet Dress Rehearsal, Moves Forward Toward Launch

NASA analyzed the data from the [wet dress rehearsal](#) conducted June 20 and determined the testing campaign complete ahead of the first launch and test flight of NASA’s Space Launch System (SLS) rocket and the Orion spacecraft for Artemis I. The agency rolled the SLS rocket and Orion spacecraft back to the Vehicle Assembly Building at Kennedy Space Center to prepare for launch. During the June 20 rehearsal, teams were able to validate the timelines and procedures for launch, including loading cryogenic – or supercold – propellant into the rocket’s tanks, performing the [launch countdown](#) through the handover to the automated launch sequencer, and draining the tanks. By reaching deep into the final phase of the countdown, teams exercised all the assets and capabilities of the entire system: SLS, Orion, and Exploration Ground Systems, including at Launch Complex 39B and other supporting locations.

## Subscale Booster Motor for Future Artemis Missions Fires Up at Marshall

Engineers successfully fired a 2-foot-diameter, subscale solid rocket booster June 1 at Marshall. The test, conducted in Marshall’s East Test Area, produced 92,000 pounds of thrust and was done as part of the booster obsolescence and life extension (BOLE) program, providing an upgraded booster design for the evolved configuration of the SLS rocket for Artemis IX and beyond. The BOLE booster will be a larger and more powerful solid rocket motor to make the SLS rocket capable of sending heavier payloads to the Moon and beyond. The test was the second in the series to evaluate the new motor design with an added half segment, a new propellant, a new aft dome design, and a new nozzle design. The [first test](#) was completed Dec. 2, 2021.



## NASA Reveals Webb Telescope's First Images of Unseen Universe

The dawn of a new era in astronomy arrived as the world got its first look at the full capabilities of NASA's James Webb Space Telescope, a partnership with the European Space Agency and the Canadian Space Agency. NASA explores the unknown in space for the benefit of all, and Webb's first observations tell the story of the hidden universe through every phase of cosmic history – from neighboring planets outside our solar system, known as exoplanets, to the most distant observable galaxies in the early universe. Webb is the world's premier space science observatory. Webb will solve mysteries in the solar system, look beyond to distant worlds around other stars, and probe the mysterious structures and origins of our universe and our place in it.

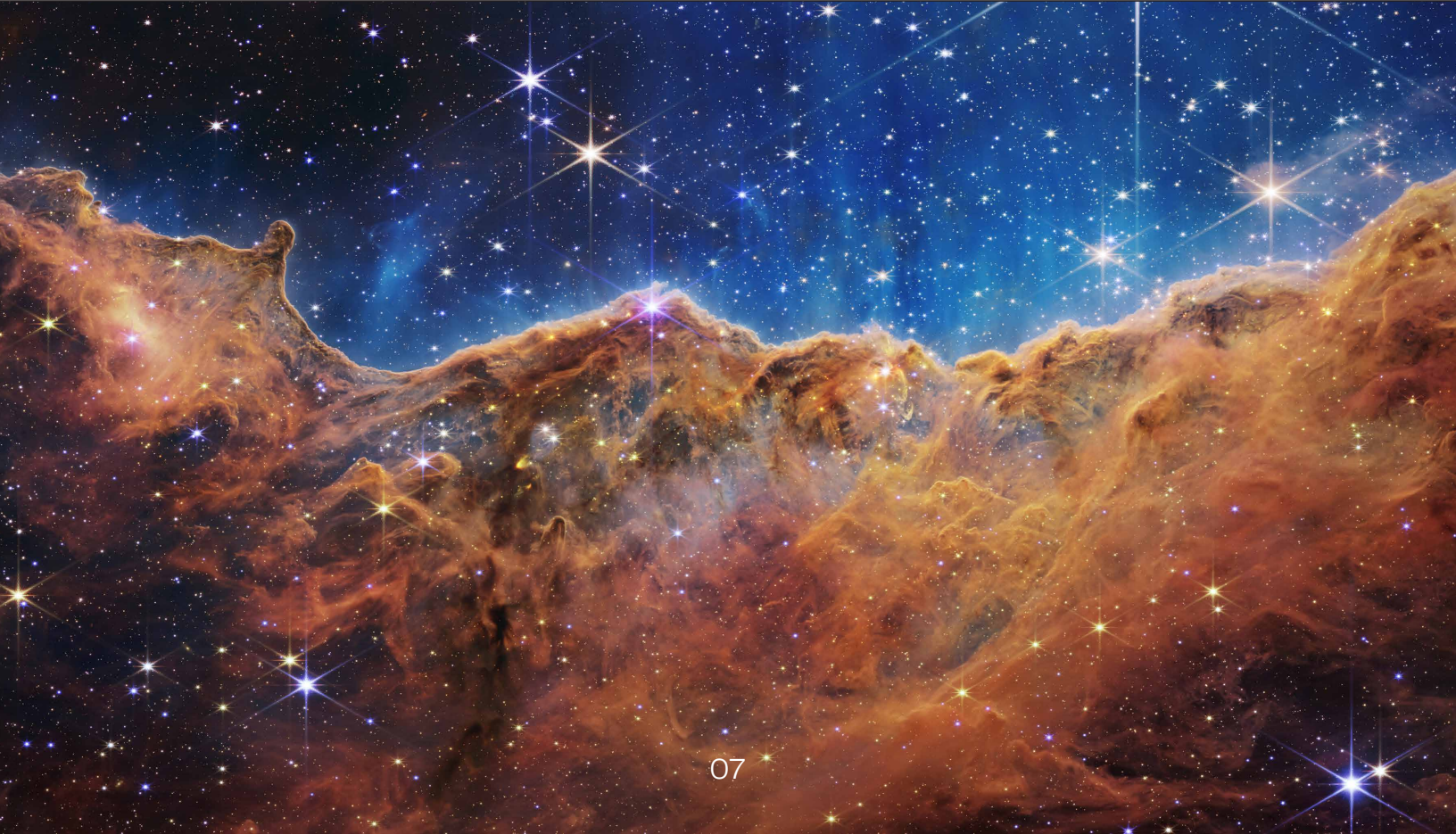
## Microgravity Science Glovebox Celebrates 20 Years of Success

Thinking outside the box propels many NASA innovations for missions exploring space and improving life on Earth. But thinking – or working – inside the box makes scientific discoveries possible aboard the International Space Station. The box is the [Microgravity Science Glovebox](#), or MSG, which celebrated its 20th anniversary aboard the space station July 8. Managed by Marshall, the unique lab is designed to closely simulate working conditions on the ground. Since MSG's installation, space station crews and scientists around the globe have conducted 63 experiments, many operating multiple times. The glovebox has accumulated 70,000 hours of operational time. The Human Exploration Development and Operations Office at Marshall held a celebration July 8, commemorating the 20th anniversary of MSG.

## NASA Completes Test Firing of Future Artemis Booster Motor

Teams from NASA's SLS Program and Northrop Grumman successfully fired a ground-based version of a future booster motor for NASA's mega Moon rocket at Northrop Grumman's test facility in Promontory, Utah. Secured horizontally in a test stand, the single five-segment booster motor [fired](#) for just over two minutes and produced 3.6 million pounds of thrust. The booster for the test, called Flight Support Booster-2 (FSB-2), is the same size and has the same power as a booster used for launch. Together, the twin solid rocket boosters on SLS produce more than 75% of the initial thrust for an Artemis launch. NASA and Northrop Grumman, the SLS booster lead contractor, are using the test data to evaluate improvements and new materials in the boosters for missions after Artemis III.

# JULY



## Marshall Engineers, Facilities, Tools Contribute to Artemis Success

Ahead of the November launch of Artemis I and the Space Launch System, an August feature in the Marshall Star highlighted Marshall's contributions to Artemis. While Artemis is an agencywide effort, many of the people, programs, and facilities that built, tested, and readied the mega rocket and other key Artemis components for this next era of spaceflight are at Marshall. Marshall has not only contributed to Artemis I, but teams are already building rockets and working on other technology and hardware needed for future missions. Click [here](#) for more about Artemis I and Marshall contributions.

## Lead-up to Launch Series Spotlights Team Members

Leading up to the first Artemis I launch attempt, the Marshall Star spotlighted team members at NASA's Marshall Space Flight Center and Michoud Assembly Facility and how they are contributing to the mission. Team members featured included Naveen Vetcha, a Centennial Challenges Program manager with Jacobs Space Exploration Group on the Engineering Services and Science Capability Augmentation contract at Marshall; Will Bryan, an SLS technical writer and editor at Marshall; NASA Pegasus barge crew, which maintains, manages, and transports the SLS core stage and other SLS hardware elements to Kennedy Space Center for launch; and Scott Huzar, manager of the Orion Launch Abort System at Marshall.



# AUGUST

## NASA'S Super Guppy Delivers Rocket Test Article to Marshall

08

Teams at Marshall unloaded the [Orion stage adapter \(OSA\)](#) structural test article from NASA's Super Guppy cargo airplane Aug. 10. The Super Guppy is capable of hauling loads of more than 48,000 pounds and boasts a cargo compartment 25 feet tall, 25 feet wide, and 111 feet long. Its unique, hinged nose can open to 110 degrees, allowing NASA teams to load and unload large hardware pieces and other oversized cargo from the front end of the craft. Engineers at Marshall designed and built the OSA test article to help prepare the agency's SLS rocket for flight. The 5-foot-tall, 18-foot-diameter test article is structurally identical to the flight version of the Orion stage adapter, which connects the rocket's interim cryogenic propulsion stage to the Orion spacecraft.



## DART Mission Hits Asteroid in First-Ever Planetary Defense Test

After 10 months flying in space, NASA's Double Asteroid Redirection Test (DART) – the world's first planetary defense technology demonstration – successfully impacted its asteroid target Sept. 26, the agency's first attempt to move an asteroid in space. As a part of NASA's overall [planetary defense](#) strategy, DART's impact with the asteroid Dimorphos demonstrates a viable mitigation technique for protecting the planet from an Earth-bound asteroid or comet, if one were discovered. The mission's one-way trip confirmed NASA can successfully navigate a spacecraft to intentionally collide with an asteroid to deflect it, a technique known as kinetic impact. Johns Hopkins Applied Physics Laboratory manages the DART mission for NASA's Planetary Defense Coordination Office as a project of the agency's [Planetary Missions Program Office](#), which is at Marshall.

# SEPTEMBER

## Setting the Clock on a Stellar Explosion

While astronomers have seen the debris from scores of exploded stars in the Milky Way and nearby galaxies, it is often difficult to determine the timeline of the star's demise. By studying the spectacular remains of a supernova in a neighboring galaxy using NASA telescopes, a team of astronomers found enough clues to help wind back the clock. The supernova remnant called SNR 0519-69.0 (SNR 0519 for short) is the debris from an explosion of a white dwarf star. Astronomers combined the data from NASA's Chandra X-ray Observatory and Hubble Space Telescope with data from the retired Spitzer Space Telescope to determine how long ago the star in SNR 0519 exploded and learn about the environment the supernova occurred in. Marshall manages the Chandra program.

## STEM Competitions Propel Students Toward NASA Careers

For many students, participating in [NASA's Human Exploration Rover Challenge](#) (HERC) steers them toward a career in the aerospace industry, including working with NASA. That was the case for Nick Benjamin and Mike Selby, two employees at Marshall who followed their rover path to a rewarding NASA career. NASA's [Student Launch](#) rocket competition can also provide participants with the knowledge and connections necessary to pursue careers in the aerospace industry. This rang true for John Inness, former student competitor turned NASA engineer at Marshall. HERC and Student Launch are part of NASA's [Artemis Student Challenges](#) and are managed by NASA's Southeast Regional Office of STEM Engagement at Marshall.



## Marshall Documents Implosion of Building 4200, Historic Administrative Facility

Building 4200, the administrative headquarters for Marshall for nearly six decades, collapsed in a controlled implosion shortly after 7:30 a.m. on Oct. 29. That event closed a big chapter of the pivotal NASA center's history, clearing the way for new missions that will take us deep into the century ahead – and even deeper into the cosmos. “We are so proud of the work we accomplished in this building,” said Marshall Director Jody Singer. “Yet Marshall's true legacy isn't a glass and stone edifice, but the men and women who work within, [the vanguard of future space frontier expansion](#) for untold decades to come.” The demolition of the 10-story structure was overseen by Target Contractors of Ladson, South Carolina. Read more about Building 4200 [here](#).

# OCTOBER

10

## NASA Leaders Look to Bright Future at Von Braun Symposium

From deep space exploration to growing the aerospace workforce, NASA executives and other industry experts discussed a wide range of topics at the 15th Wernher von Braun Memorial Symposium. A creative team effort was the central message of the annual event, which was held at the University of Alabama in Huntsville. The American Astronautical Society hosted the three-day conference. “I am so incredibly proud of our team at Marshall Space Flight Center. Capabilities and needs are changing, and Marshall has changed and will continue to evolve,” Marshall Director Jody Singer said in her opening remarks. “We truly are a 21st century space transportation center, with expertise in design, development, testing, and operations.” The theme for the symposium was “Space at the Table: Collaboration, Cooperation, and Inclusion.”

## Federal Employees Viewpoint Survey Marks Record Response at Marshall

For an unprecedented 10 straight years, 2012-2021, NASA ranked as the [Best Place to Work in the Federal Government](#) among large agencies. Early findings in the latest [Federal Employee Viewpoint Survey](#) suggest that trend could continue for 2022 as leaders at NASA and Marshall pore over the data to further improve workflows, morale, and productivity agencywide. Part of the annual government-wide survey administered by the Office of Personnel Management in Washington, the employee survey is open to all full-time and part-time civil servants. It is designed to provide administrators with insight about employee satisfaction – and gives team members an important platform to suggest ways to improve workplace culture, conditions, and efficiency across the federal government. A record 73% of Marshall civil servants responded to the survey.

# LIFTOFF!

## NASA's Artemis I Mega Rocket Launches Orion to Moon

Following a successful launch of NASA's SLS, the most powerful rocket in the world, the agency's Orion spacecraft headed to the Moon as part of the Artemis program. Carrying an uncrewed Orion, SLS lifted off for its flight test debut at 1:47 a.m. EST/12:47 a.m. CST Nov. 16 from Launch Pad 39B at NASA's Kennedy Space Center. The launch was the first leg of a mission in which Orion planned to travel approximately 40,000 miles beyond the Moon and return to Earth over the course of 25.5 days. Known as Artemis I, the mission is a critical part of NASA's Moon to Mars exploration approach, in which the agency explores for the benefit of humanity. It's an important test for the agency before flying astronauts on the [Artemis II](#) mission.

# NOVEMBER

## Marshall Event Displays Largest Solar Sail Section Ever Deployed

Media members were invited to take pictures and video of NASA's newest solar sail after a successful deployment test in Building 4316 at Marshall. The sail is a full-scale prototype of one of the four sections, or quadrants, designed for the Solar Cruiser spacecraft. Solar sails use the force of light – not rocket fuel – to fly in deep space. They get a gentle, constant push from sunlight particles, or photons, hitting their giant reflective surfaces. Over time, solar sails can travel farther than traditional spacecraft, faster, and maybe one day reach other stars. The fully deployed sail covers an area larger than the surface of a tennis court. A team led by Marshall is developing the Solar Cruiser mission to mature solar sail technology for future mission use.

## LOFTID Inflatable Heat Shield Test a Success

NASA's [LOFTID](#) technology demonstration hitched a ride to space with NOAA's JPSS-2 weather satellite on Nov. 10. JPSS-2 is expected to help improve weather forecasts, and LOFTID – Low-Earth Orbit Flight Test of an Inflatable Decelerator – is an inflatable heat shield that could protect spacecraft during atmospheric entry and re-entry. Following JPSS-2's deployment, the LOFTID heat shield autonomously inflated and re-entered Earth's atmosphere, splashing down about 500 miles off the coast of Hawaii just over two hours and ten minutes after launch. The LOFTID project is managed and funded through NASA's Technology Demonstration Missions program, part of the agency's Space Technology Mission Directorate. The project is led by NASA's Langley Research Center, with contributions from NASA's Ames Research Center, Marshall, and Armstrong Flight Research Center.

## 15 Teams Advance in NASA's \$3.5M Break the Ice Lunar Challenge

NASA announced the 15 semifinalist teams advancing in the agency's Break the Ice Lunar Challenge, a multi-level incentive prize competition aimed at advancing technology development for in situ resource utilization on the Moon. Thirteen U.S. teams and two international teams will move on to build and test prototype systems for excavating and transporting icy lunar regolith. The winning U.S. teams will be awarded an equal share of the \$500,000 prize purse. The Break the Ice Lunar Challenge is a NASA Centennial Challenge led by NASA's Marshall Space Flight Center and Kennedy Space Center.

## Crew-4 Mission Astronauts Make Debut Visit to Marshall

The Human Exploration Development & Operations Office at Marshall hosted SpaceX Crew-4 astronauts who are part of NASA's Commercial Crew Program Dec. 8. This was the first post-flight visit from a commercial crew to the center since before the COVID-19 pandemic began. NASA astronauts Kjell Lindgren, commander; Bob Hines, pilot; and Jessica Watkins, mission specialist; and ESA (European Space Agency) astronaut Samantha Cristoforetti, mission specialist, were part of the agency's fourth commercial crew mission to the International Space Station, which launched April 27 from Kennedy Space Center and returned Oct. 14, splashing down off the coast of Jacksonville, Florida. The visit was sponsored by Marshall's Payload Operations Integration Center, which operates, plans, and coordinates the science experiments onboard the space station 365 days a year, 24 hours a day.

# DECEMBER

12

## SPLASHDOWN! NASA's Orion Returns to Earth After Historic Moon Mission

NASA's Orion spacecraft splashed down in the Pacific Ocean west of Baja, California, at 11:40 a.m. CST on Dec. 11 after a record-breaking mission. Orion traveled more than 1.4 million miles on a path around the Moon before returning safely to Earth, completing the [Artemis I](#) flight test. Splashdown is the final milestone of the Artemis I mission that began with a successful liftoff of NASA's Space Launch System (SLS) rocket Nov. 16. Over the course of 25.5 days, NASA tested Orion in the harsh environment of deep space before flying astronauts on [Artemis II](#). "The splashdown of the Orion spacecraft – which occurred 50 years to the day of the Apollo 17 Moon landing – is the crowning achievement of Artemis I," said NASA Administrator Bill Nelson.

