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National Aeronautics and
Space Administration

KENNEDY SPACE CENTER'S

SPACEPORT magazine

Final Delta II Rocket Carries NASA's ICESat-2 to Measure Earth's Ice

KENNEDY SPACE CENTER'S

SPACEPORT MAGAZINE

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The final United Launch Alliance Delta II rocket lifts off from Space Launch Complex 2 at Vandenberg Air Force Base in California, on Sept. 15, 2018, carrying NASA's Ice, Cloud and land Elevation Satellite-2 (ICESat-2). Liftoff was at 9:02 a.m. EDT (6:02 a.m. PDT). The satellite will measure the height of our changing Earth, one laser pulse at a time, 10,000 laser pulses per second. ICESat-2 will provide scientists with height measurements that create a global portrait of Earth's third dimension, gathering data that can precisely track changes of terrain, including glaciers, sea ice and forests. Photo Credit: NASA/Kim Shiflett

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SPACE CENTER

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I advise Center Planning and Development and Spaceport Integration on issues related to Partnership agreement development and implementation. I'm often intimately involved in the negotiation of partnership agreements, including the leases and service agreements that allow our partners access to unique Kennedy Space Center resources in conjunction with their activities at the multi-user spaceport.

When I graduated from law school, I was lucky enough to land a federal job in the civil service as an attorney for the Corps of Engineers. The skills I learned there prepared me well for practice as a NASA attorney. My wife is originally from Florida, and my interest in moving here and in the space program led me to Kennedy. I have worked here since 2013 and have supported Center Planning and Development since early 2016.

It is easy to focus on the immediate task at hand, but it's imperative to maintain cognizance of the center's long-term mission as a multi-user spaceport. My biggest challenge is maintaining focus on that long-range mission when the many short-term activities and needs involved in that mission demand daily attention. The great team around me allows me to focus on the future by regularly engaging me in a discussion regarding the path forward and upward.

I can't wait to see what we accomplish in the next 20 years!

Measuring Earth's Ice

ICESat-2 successfully launched on final flight of Delta II rocket

BY ANNA HEINEY

NASA's Launch Services Program (LSP), based at Kennedy Space Center in Florida, launched the Ice, Cloud and land Elevation Satellite-2 (**ICESat-2**) on a three-year mission to measure the ice of Earth's frozen and icy areas after a successful liftoff Sept. 15, 2018, at 6:02 a.m. PDT (9:02 a.m. EDT) from Space Launch Complex-2 at Vandenberg Air Force Base in California. The spacecraft was delivered to Earth orbit by the United Launch Alliance Delta II rocket, which completed its final launch after 29 years in service.

"With this mission we continue humankind's exploration of the remote polar regions of our planet and advance our understanding of how ongoing changes of Earth's ice cover at the poles and elsewhere will affect lives around the world, now and in the future," said Thomas Zurbuchen, associate administrator of NASA's Science Mission Directorate.

Using its only onboard instrument, the Advanced Topographic Laser Altimeter System (**ATLAS**), ICESat-2 will gather enough data to estimate the annual height change of the Greenland and Antarctic ice sheets to within four millimeters — the width of a pencil.

The high-resolution data will document changes in the Earth's polar ice caps and improve forecasts of sea level rise bolstered by ice sheet melt in Greenland and Antarctica. It also will help scientists understand the mechanisms that are decreasing floating ice and assess how that sea ice loss affects the ocean and atmosphere.

ICESat-2 builds upon the record of ice height measurements started by NASA's original ICESat mission, which operated from 2003 to 2009. These measurements were continued by the agency's annual Operation IceBridge airborne flights over the Arctic and Antarctic, which began in 2009. Data from ICESat-2 will be available to the public through the **National Snow and Ice Data Center**.

The first ICESat mission launched in January 2003, also on a Delta II from Vandenberg.

"I'm thrilled that we were able to close the chapter on Delta II with a huge success for an incredibly important science payload," said NASA Launch Manager Tim Dunn.

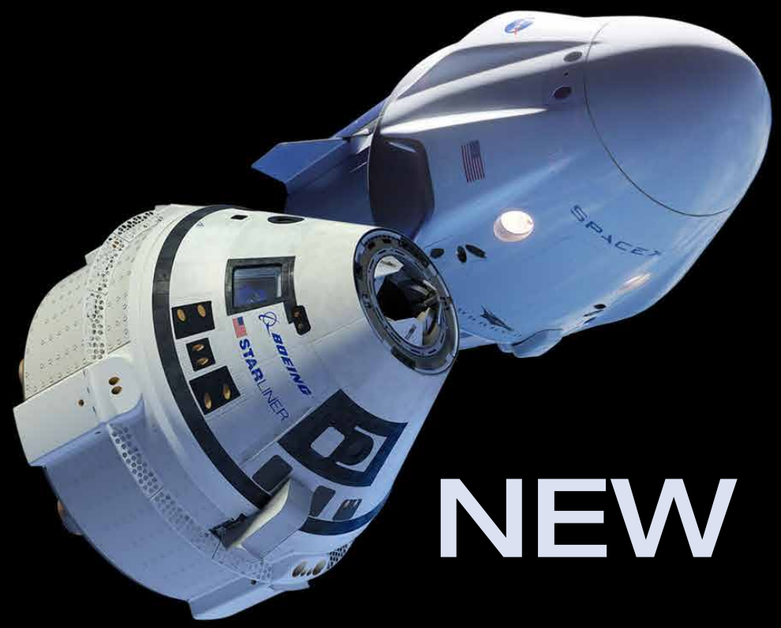
"ICESat-2 is going to do cutting-edge scientific data gathering; the precision measurements it's going to make from space are going to be incredible. So to be able to say we launched this very important science mission on the final flight of the industry workhorse is just a huge accomplishment for the entire team," he added.

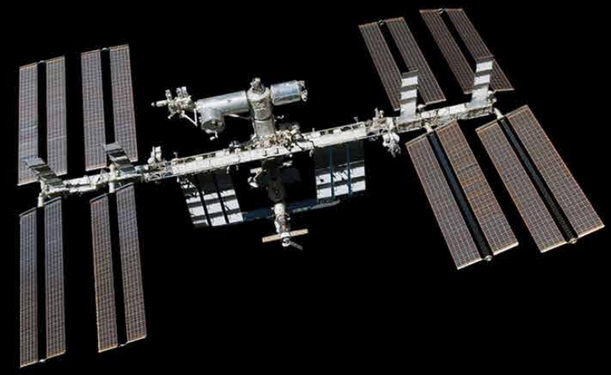
A host of small satellites, known as CubeSats, also were carried into space aboard the Delta II. Managed by LSP, the Educational Launch of Nanosatellites (**ELaNa**) XVIII payload included University of Central Florida's SurfSat; California Polytechnic State University's DAVE (Damping and Vibration Experiment); and UCLA's ELFIN (Electron Losses and Fields Investigation (ELFIN) and ELFIN-STAR (Spatio-Temporal Ambiguity Resolution). The CubeSats, which flew inside Poly Picosatellite Orbital Deployers (P-PODs) mounted to the rocket's second stage, were successfully deployed on time, more than an hour after liftoff.

(Above) At Space Launch Complex 2 at Vandenberg Air Force Base in California, technicians prepare three poly picosatellite orbital deployers, or P-POD containers, with tiny satellites, called CubeSats inside, for installation on the second stage of the United Launch Alliance Delta II rocket, on Aug. 31, 2018. Photo credit: USAF 30th Space Wing/Julio Paz

(Right) The first half of the United Launch Alliance Delta II payload fairing is secured around NASA's Ice, Cloud and land Elevation Satellite-2 (ICESat-2) on Sept. 4, 2018, at Space Launch Complex 2 at Vandenberg Air Force Base in California. Photo credit: USAF 30th Space Wing/Alex Valdez

The United Launch Alliance Delta II rocket launches with the NASA Ice, Cloud and land Elevation Satellite-2 (ICESat-2) on board, Sept. 25, 2018, from Vandenberg Air Force Base in California. Photo credit: NASA/Bill Ingalls





NEW ERA IN SPACEFLIGHT

Launch dates to be updated more regularly as Commercial Crew flights draw nearer

As NASA's Commercial Crew partners Boeing and SpaceX crew transportation systems are within months of being ready for the first test flights of their spacecraft that will carry astronauts to and from the **International Space Station** from U.S. soil, the scheduling of launch dates enters a new phase.

The near-term scheduling balances the commercial partners' readiness with NASA and the International Space Station's schedule and the availability of the Eastern Range to establish a target launch date. NASA plans to provide up-to-date launch planning dates on the **Commercial Crew blog**, which will be updated approximately monthly, with near-term launches also appearing on NASA's **launches and landing** schedule.

"As we get closer to launching human spacecraft from the U.S., we can be more precise in our schedules," said Phil McAlister, director of Commercial Spaceflight Development at NASA Headquarters. "This allows our technical teams to work efficiently toward the most up-to-date schedules, while allowing us to provide regular updates publicly on the progress of our commercial crew partners."

SpaceX and the Commercial Crew Program are working together to have the hardware and associated activities ready for its first test flight – Demo-1 – in December 2018, but the launch will occur in January to accommodate docking opportunities at the orbiting laboratory. Boeing's targeted readiness for its Orbital Flight Test is March 2019. Both test flights will be uncrewed missions.

NASA astronauts **Bob Behnken** and **Doug Hurley** are training to fly on SpaceX's Crew Dragon Demo-2 mission, with a planning date of June 2019. NASA astronauts **Eric Boe** and **Nicole Aunapu Mann** and Boeing astronaut **Chris Ferguson** are slated for Boeing's Crew Flight Test targeted for August 2019.

As with all human spaceflight development, learning from each test and adjusting as necessary to reduce risk to the crew may override targeted launch dates.

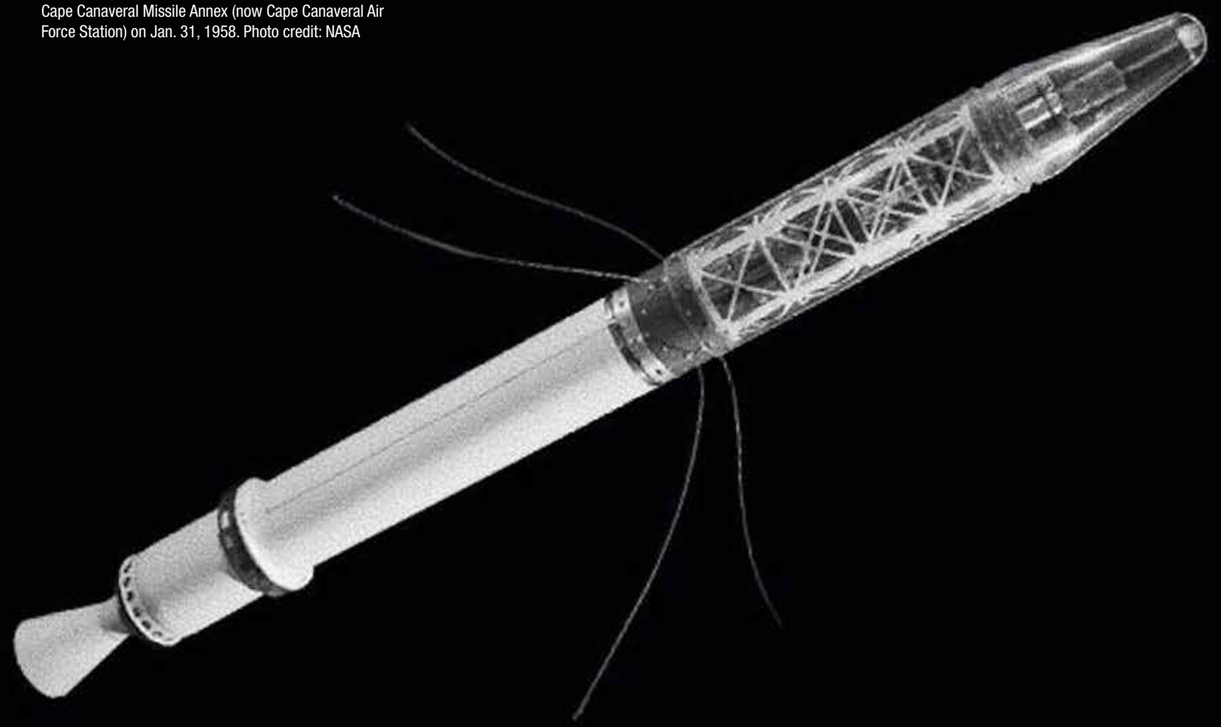
"This new process for reporting our schedule is better; nevertheless, launch dates will still have some uncertainty, and we anticipate they may change as we get closer to launch," McAlister said. "These are new spacecraft, and the engineering teams have a lot of work to do before the systems will be ready to fly."

Following the test flights, NASA will review the performance data and resolve issues as necessary to certify the systems for operational missions. The readiness date for the first long-duration Expedition crew mission is targeted for August 2019 and a second mission is targeted in December 2019, with the specific spacecraft yet to be determined.

Boeing and SpaceX have made significant strides in the development and operation of a new generation of spacecraft and launch systems in partnership with **NASA's Commercial Crew Program**. This public-private partnership marks the beginning of a new era of human spaceflight to design, develop, and test their systems to ensure safe, reliable and cost-effective commercial transportation for astronauts to low-Earth orbit. The success of these human spaceflight systems will be an unprecedented achievement for the commercial space industry and will enable NASA to focus on deep space exploration with **NASA's Orion spacecraft** and **Space Launch System**, as we return humans to the Moon and on to Mars.

An artist image of Boeing's CST-100 Starliner spacecraft and SpaceX's Crew Dragon spacecraft above Earth with the International Space Station in the distance. Image credit: NASA/Matthew Young

NASA is partnering with Boeing and SpaceX to build a new generation of human-rated spacecraft capable of taking astronauts to the International Space Station and expanding research opportunities in orbit. The upcoming flight tests are part of NASA's Commercial Crew Transportation Capability contract with the goal of returning human spaceflight launch capabilities to the United States.



Explorer 1 was the first U.S. satellite and the first to carry scientific instruments. The satellite was launched from the Cape Canaveral Missile Annex (now Cape Canaveral Air Force Station) on Jan. 31, 1958. Photo credit: NASA

Click on the image for more information.

Click on the image for more information.

The X-15 #2 launches away from the B-52 mothership with its rocket engine ignited. Photo Credit: NASA

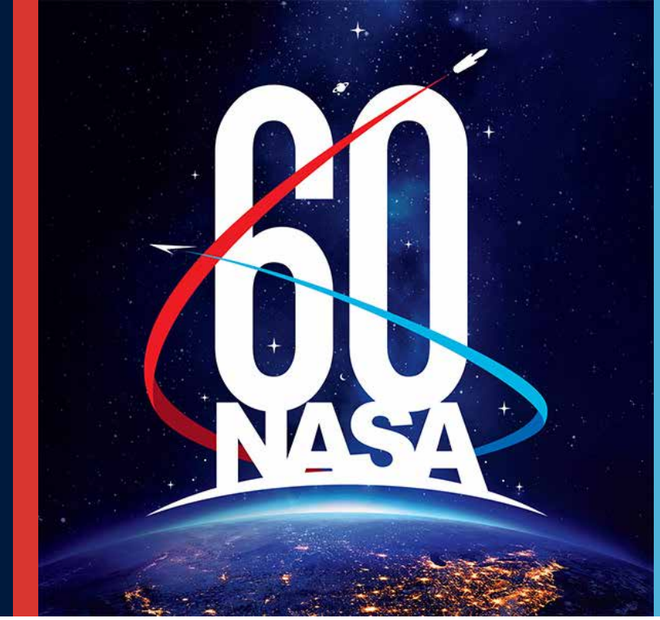


Image credit: NASA

NASA: 60 Years and Counting

From 2018 through 2022, NASA is marking a series of important milestones – the 60th anniversary of the agency's founding by Congress in 1958, and the 50th anniversary of the Apollo missions that put a dozen Americans on the Moon between July 1969 and December 1972. Celebrations already are under way. Some are complete, some are scheduled in the coming months, and some are still being planned.

The celebrations continued June 1-2 with "**Space, the Next Frontier**," a tribute to NASA by the National Symphony Orchestra Pops at the Kennedy Center for the Performing Arts in Washington. The center is named for President John F. Kennedy, who had not only a vision for cultural advancement, but also a vision for technological advancement in the form of landing Americans on the Moon. Kennedy's legacy to the space program was highlighted along with six decades of NASA achievements in an exhibition at the Kennedy Center's Hall of Nations.

In July, NASA marked the 60th anniversary of its formation by the passage of the National Aeronautics and Space Act. One of the federal agencies absorbed into NASA was the National Advisory Committee on Aeronautics, which by 1958 had already begun sending pilots to the upper reaches of the atmosphere. NASA's story begins with the **transformation of the NACA into NASA and planes into spacecraft**.

Explorer 1

NASA kicked off its 60th anniversary Jan. 31 by remembering the 1958 launch of the **first U.S. satellite, Explorer 1**, from Cape Canaveral, Fla. An experiment on the satellite discovered belts of charged particles trapped in space by Earth's magnetic field, now known as the Van Allen Belts.

NASA also is preparing to mark the 50th anniversary of the Apollo program, starting this month with the anniversary of the launch of Apollo 7. On Oct. 11, at the National Air and Space Museum in Washington, the U.S. Mint will unveil the design for an Apollo 11 commemorative coin that will go on sale in January 2019.

In December, NASA will join the National Air and Space Museum in recalling the 50th anniversary of the flight of Apollo 8, whose crew of three spent Christmas 1968 in orbit around the Moon. The focus will turn to Apollo 11 in July 2019. Celebrations are planned in Washington and at NASA centers that were crucial to the success of the Apollo Program. On July 19, NASA TV will broadcast live from the refurbished Apollo Mission Operations Control Room at NASA's Johnson Space Center and several other locations with Apollo connections coast to coast.

Inside the Space Station Processing Facility high bay at NASA's Kennedy Space Center, technicians work on the pump package assembly (PPA) on Aug. 30, 2018. The payload will be carried to the International Space Station on SpaceX's 16th Commercial Resupply Services mission. The PPA will be used to continuously drive the cooling water in the space station's thermal control system. The assembly includes a centrifuge pump, a fine filter and gas trap for pump protection, a coarse outlet filter, sensors, and an accumulator. The PPA also will provide a reservoir used for makeup of coolant if leakage occurred. CRS-16 is scheduled to launch to the space station later this year. Photo credit: NASA/Glenn Benson

ICON to study region where Earth, space weather meet

Inside the Northrop Grumman facility in Gilbert, Arizona, NASA's Ionospheric Connection Explorer, or ICON, satellite is tilted on a work stand for inspection on June 12, 2017. It later was shipped to Vandenberg Air Force Base in California for mating to the Pegasus XL rocket. Photo credit: Northrop Grumman

Space Weather Satellite Mission: NASA's Ionospheric Connection Explorer, or ICON

Launch: 4:00 a.m. EDT on Friday, Oct. 26, 2018

Lift Off: Northrop Grumman Pegasus XL rocket carried aloft by an L-1011 Stargazer aircraft

Aircraft Take-off: Skid Strip at Cape Canaveral Air Force Station in Florida

Launch Vehicle: Pegasus XL rocket, 57 feet long, 4.2 feet in diameter

ICON Satellite: 634 pounds

Payload: The ICON satellite will study the dynamic region high in the atmosphere where terrestrial weather meets weather in space.

For more on ICON:
https://www.nasa.gov/icon

Design Improvements

Kennedy team puts space sensor to use on the ground

BY LEEJAY LOCKHART

NASA Kennedy Space Center's use of a technology widely employed in sophisticated manufacturing supports the agency's space exploration efforts and also has led to improvements in the product's design.

The technology is a sensor called a residual gas analyzer/mass spectrometer, or RGA. At each step in the process of producing complex items like semi-conductors, which can involve thousands of RGAs for process control, the devices can rapidly detect vacuum leaks as well as contamination that, if left unchecked, could result in manufacturing defects. RGAs also can determine the type and location of a leak by identifying its chemical composition.

A team at Kennedy leveraged their experience working with RGAs while they worked with members of industry to troubleshoot Kennedy's thermal vacuum chamber, or TVAC. The chamber can simulate various space environments to test and prepare hardware for flight.

The NASA researchers, members of the Water Analysis and Volatile Extraction (WAVE) team, are developing RGAs as payloads for landers to detect resources on the Moon, such as water that astronauts can drink or convert to rocket fuel. During testing of the TVAC, engineers had detected pressure spikes indicative of small, invisible leaks. The WAVE team and members of industry demonstrated how to use a RGA sensor to troubleshoot the leaks by identifying gases present in the chamber which would indicate the source of a leak, thus avoiding a costly and time-consuming delay to operations.

This was not their first collaboration.

The NASA researchers had already put their RGA through numerous flight verifications, and had worked with the vender to resolve issues that arose when adapting the technology for space. Vibration testing, in particular, highlighted several ways in which RGA manufacturers could make their devices more robust. Ken Wright, chief scientist and instrument development lead for sensor manufacturer Inficon, said working with NASA produced at least three direct improvements to the company's residual gas analyzer. "Our main product is now better because of this collaboration," Wright said.

Janine Captain, a researcher at Kennedy, at left, and Dan Ciarlariello, thermal vacuum chamber engineer, center, discuss best practices for using a residual gas analyzer/mass spectrometer to detect leaks and contamination in a vacuum with Ken Wright, chief scientist and instrument development lead for sensor manufacturer Inficon, at right. The TVAC can simulate various space environments to test and prepare hardware for flight. Photo credit: NASA

Janine Captain, a researcher at Kennedy, said the work was beneficial to everyone involved. "This collaboration makes the center stronger and better equipped to provide testing facilities to our customers," she said. "Working with commercial providers enables us to continue expanding our capabilities."

Employing the RGA sensor to troubleshoot Kennedy's thermal vacuum chamber while preparing the same equipment for use in space is another example of harnessing innovation to develop the agencies capabilities and using technology to drive exploration.

NASA's Kennedy Space Center Innovators' Launchpad:

Michael D. Hogue

Please explain your job in a single sentence.

I am a Ph.D. physicist who performs research into the electrostatics and electrodynamics of extraterrestrial regoliths.

What do you find most exciting about your job as a lab manager and researcher for NASA's Kennedy Space Center's Electrostatics and Surface Physics Laboratory (ESPL)?

I like to develop new things and new knowledge to support America's space program. Besides, it is fun.

What is a typical day like for you?

A typical day entails ensuring lab safety in the pursuit of our various research projects, ensuring the calibration and availability of lab equipment. I also am a principle investigator or a co-investigator for various projects in the ESPL and I do research and development in support of these projects. Additionally, I develop proposals for new work.

Was your first month at NASA anything like your current work?

I was like a deer in the headlights my first month here as an intern, or co-op student, as they were called then. Working for NASA was a dream job that I was blessed to strive for and earn. I knew that I wanted to do science, and through the years here at Kennedy I have worn many hats but always came back to science. Now that I have my Ph.D. in physics and am working research and development to further our mission of exploration and discovery, I am still quite awed.

What is your educational background and why did you choose to study those areas?

I have a Master of Science in space systems from the Florida Institute of Technology and a Ph.D. in physics from the University of Central Florida. I have always enjoyed science and working for NASA. I can say that I have a job that I love to do.

How do the era and place in which you grew up shape how you approach your work?

I grew up in rural Mississippi and my interest in science made me a rather odd person in my high school class. Science fiction and the Moon landings had always helped fuel my desire to become a part of the space program. I saw from my upbringing that only hard work, preceded by and in parallel with even harder thinking, would bring results.

What motivated you to want to work for NASA?

My love of science and space exploration.

Why does conducting research and developing new technology matter to you?

Research and development is what creates new knowledge, products, and processes, which help make human life better.

What is the most challenging problem you have overcome or are currently working on at NASA?

The most difficult problem I had was getting the necessary education to do the job I wanted to do. Fortunately, the NASA graduate fellowship program helped greatly in that respect.

How do you think your NASA research or the agency as a whole benefits people on Earth?

My research is into the electrostatics and electrodynamics of extraterrestrial regolith, ground support equipment, and flight hardware. This body of work will help make it safer for people to access space.

Do you have any advice for people about trying to foster innovation in their workplaces?

Seek ways to do things better. Learn to think "outside the box."

Mobile Launcher on the Move

NASA's mobile launcher, atop crawler-transporter 2, traveled from Launch Pad 39B to the Vehicle (VAB) Assembly Building at the agency's Kennedy Space Center in Florida, on Sept. 7, 2018. Arriving late in the afternoon, the mobile launcher stopped at the entrance to the VAB.

Early the next day, Sept, 8, engineers and technicians rotated and extended the crew access arm near the top of the mobile launcher tower. Then the mobile launcher was moved inside High Bay 3, where it will spend about seven months undergoing verification and validation testing with the 10 levels of new work platforms, ensuring that it can provide support to the agency's Space Launch System (SLS).

The 380-foot-tall structure is equipped with the crew access arm and several umbilicals that will provide power, environmental control, pneumatics, communication and electrical connections to the SLS and Orion spacecraft. Exploration Ground Systems is preparing the ground systems necessary to launch SLS and Orion on Exploration Mission-1, missions to the Moon and on to Mars.

NASA's mobile launcher is inside High Bay 3 at the Vehicle Assembly Building (VAB) on Sept. 11, 2018, at NASA's Kennedy Space Center in Florida. Photo credit: NASA/Frank Michaux

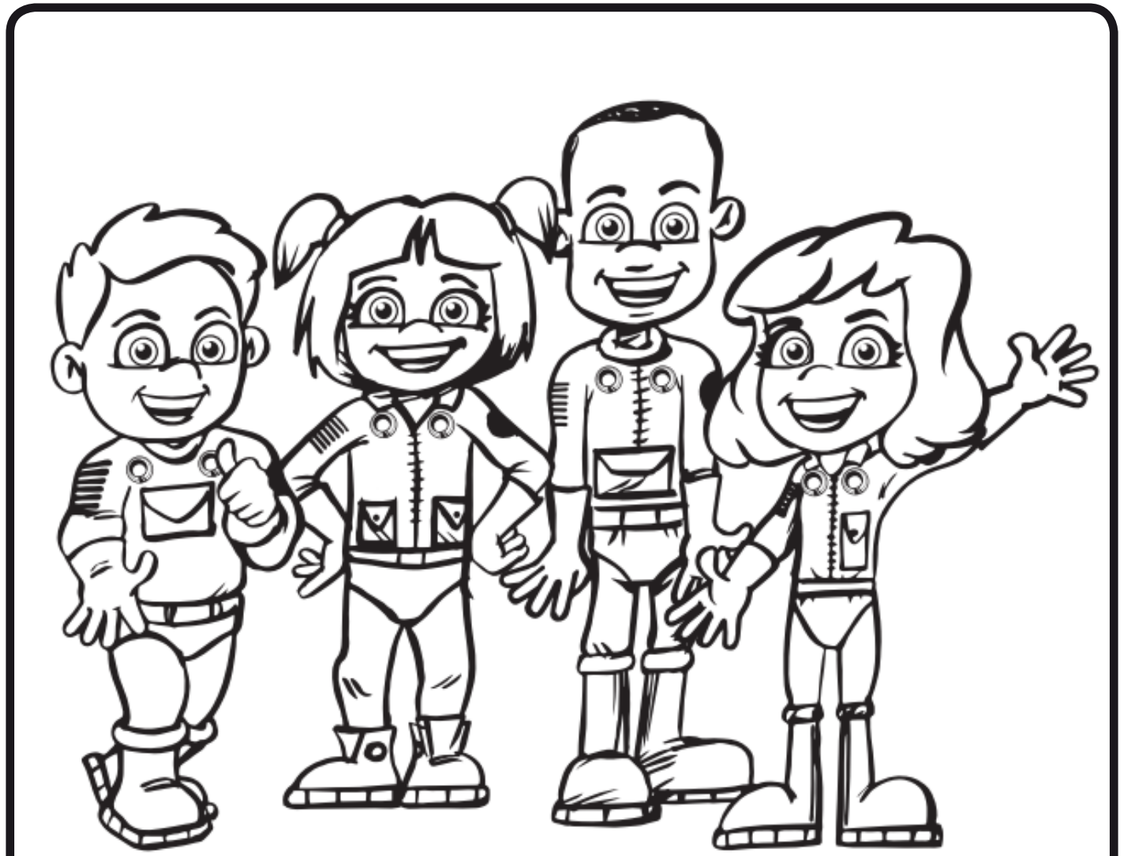
Cliff Lanham, NASA project manager for the mobile launcher, takes a break to attend the employee event for the mobile launcher move to the Vehicle Assembly Building on Sept. 7, 2018, at NASA's Kennedy Space Center in Florida. The mobile launcher, atop crawler-transporter 2, began its trek from Launch Pad 39B along the crawlerway after undergoing a fit check and several days of systems testing with the pad. This is the first time that the modified mobile launcher made the trip to the pad. Photo credit: NASA/Cory Huston

A dolphin surfs in the wake of a research boat in a waterway at NASA's Kennedy Space Center. The Florida spaceport shares boundaries with the Merritt Island National Wildlife Refuge, including the land and waterways within its 144,000 acres. Photo credit: NASA/KEMCON/Russ Lowers

Kennedy Space Center Annual Sustainability Report Now Available

NASA's sustainability policy is to execute the agency's mission without compromising our planet's resources so that future generations can meet their needs. This also means taking action now to provide a future where the environment and living conditions are protected and enhanced. In implementing sustainability practices, NASA manages risks to mission, the environment and to our communities. To this end, NASA seeks to use public funds efficiently and effectively, promote the health of the planet, and operate in a way that benefits our neighbors.

View the Fiscal Year 2017 Sustainability Report at https://go.nasa.gov/2Q0iyhX.



Commercial Crew 2019 Artwork Calendar Contest

NASA's Commercial Crew Program is partnering with private companies to develop new spacecraft to fly astronauts on NASA missions to the International Space Station, and we want kids to have a fun way to learn more about this program while being creative!

The Commercial Crew Program is holding an artwork contest from Sept. 17 through Oct. 17 for children around the world ages four to 12 years old. The winning artwork will be used to create a 2019 calendar with different space-related themes for each month. The themes educate students about the **International Space Station**, astronauts, growing food in space and more! Unique and original artwork will be selected for each month. Once the calendar is complete, it will be transmitted to astronauts aboard the space station. The calendar also will include supplemental education materials for kids here on Earth to learn more about the space-related themes.

For more information about the competition's themes, rules and deadlines plus the entry form, download the **PDF**. Get your parent's permission, of course!

The Orion crew module pressure vessel for Exploration Mission-2 is in a work stand called the bird cage inside the Neil Armstrong Operations and Checkout Building high bay at NASA's Kennedy Space Center on Sept. 11, 2018. The pressure vessel was transported in its Crew Module Transportation Fixture by super-wide transport truck from Michoud Assembly Facility near New Orleans. The pressure vessel is Orion's primary structure that holds the pressurized atmosphere astronauts will breathe and work in while in the vacuum of deep space. Photo credit: NASA/Frank Michaux

SpaceX installed the Crew Access Arm at Launch Pad 39A at NASA's Kennedy Space Center in Florida. Photo credit: SpaceX

TO THE EDGE OF SPACE

Students turn NASA robotic experience to high altitude technology

BY BOB GRANATH

Community college students who participated in NASA's **Swarmathon** robotic programming competition at the agency's Kennedy Space Center in Florida recently contributed to a program that tests technology at the edge of space. Their efforts may help astronauts find resources while exploring the Moon or Mars and could contribute to robotic satellite servicing missions.

The students from Durham Technical Community College in North Carolina participated in the **High Altitude Student Platform**, or HASP, upper atmospheric balloon program of NASA's Wallops Flight Facility in Virginia.

HASP is a platform set up so teams can mount payloads on a gondola launched into near space on a balloon, and is funded by the agency's **Minority University Research and Education Project** (MUREP). The payloads are conceived, designed and built by college and university students and can achieve a variety of goals.

Dan Koris, team lead for Durham Tech's participation in both the Swarmathon and HASP projects, noted that it started with the Swarmathon.

"The skills I learned and gained, opportunities I had, led to participation in this year's HASP project," he said.

The HASP program was established to provide flight opportunities on a helium-filled balloon carrying multiple payload experiments to near-space altitudes for up to 20 hours.

Fellow Durham Tech students Meredith Murray and Soham Pai Kane are the other members of the Swarmathon team who participated in the HASP effort.

Earlier this year, the Swarmathon competition involved progrmming **Swarmies**, small robotic vehicles. The robots searched arenas, looking for "resources" in the form of small cubes with "AprilTags" similar to bar codes.

"During the Swarmathon, students gain experience with code integration, hardware testing, software engineering, project management and team collaboration critical to their future success in robotics and computer science," said Theresa Martinez, MUREP STEM Engagement manager in Kennedy's Academic Engagement Office. "Their efforts will further advance 'swarm robotics' technology for future NASA space exploration missions to the Moon and Mars. We hope some students will return and help us."

At the conclusion of this year's robotics event, the 13-member Durham Tech team was presented the first-place award, receiving a $5,000 cash prize.

"Our rovers performed much better than I could have ever believed," said Kane, who was a software engineer for the Swarmathon. "As perfectionists, we couldn't help but worry about minor code 'bugs' that could keep us from our maximum potential. But, we were more than satisfied with the outcome."

In addition to winning the physical competition, the Durham Tech team was awarded second place for their team technical report and first place for the team video.

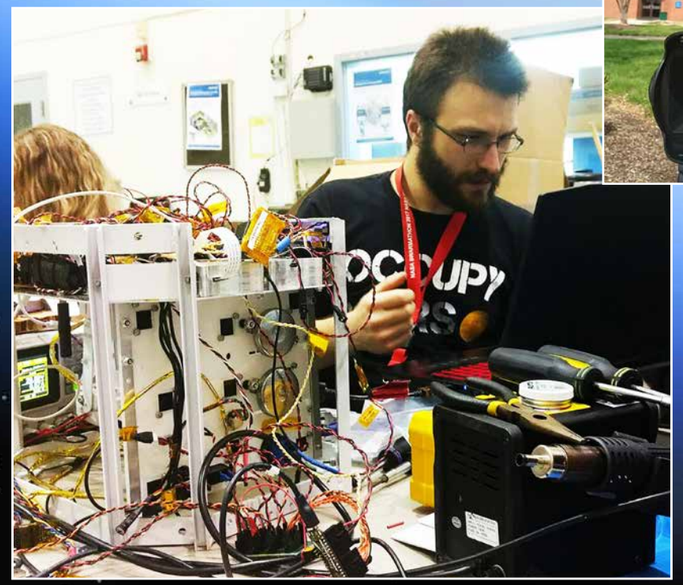
As social media and communications coordinator for the group, Murray was the primary producer of the video documentary.

"This was a huge learning experience for me," said Murray, "It involved a lot of trial and error. But we succeeded because we have good leadership that knows how to utilize people and talents. We have team members who are curious individuals that are willing to work a problem until solved."

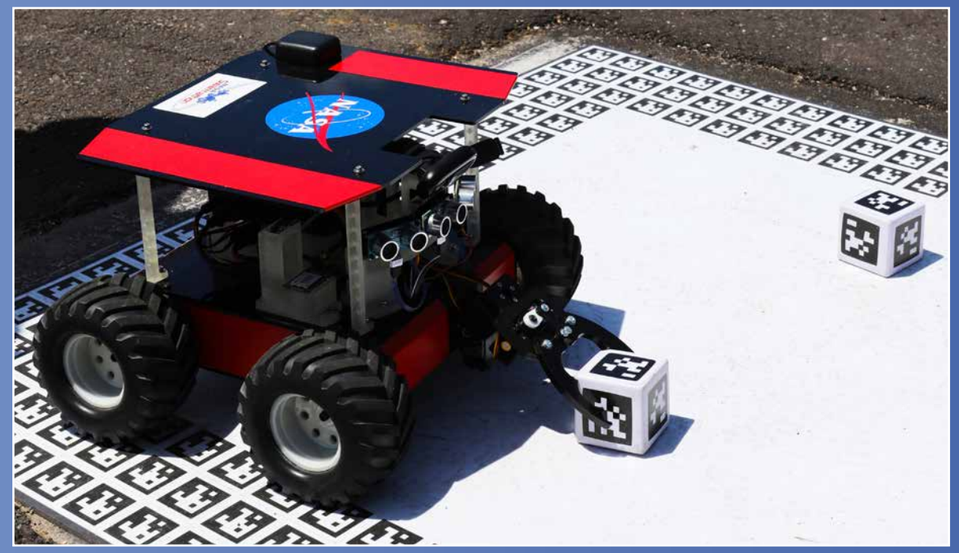
While working on their successful Swarmathon project, Koris, Murray, Kane and seven other HASP team members submitted an application to be a part of the 2018 balloon flight. Durham Tech's team was one of only 13 colleges accepted to participate in this

Viewed during flight from an on-board television camera, the Robotic Arm Manipulation and Materials Matching, or RAM3, flips switches and turns knobs during a balloon flight at 120,000 feet. The experiment was developed by a High Altitude Student Platform team from Durham Technical Community College, in Durham, North Carolina. Above the knobs and switches are bar codes similar to those on the cubes used in the Swarmathon competition. Along "for fun" is a toy dog. Photo credit: Durham Technical Community College/Chris Fields

As social media and communications coordinator for the Durham Technical Community College Swarmathon group, Meredith Murray was the primary producer of the team's award-winning video documentary. Photo credit: Durham Technical Community College/Meredith Murray



In a hangar at the Columbia Scientific Balloon Facility in Palestine, Texas, Dan Koris, software and electrical team lead for Durham Tech's participation in the balloon program, helps assemble and test the team's Robotic Arm Manipulation and Materials Matching, or RAM3. The experiment was developed for flight aboard a NASA balloon as part of the High Altitude Student Platform program. Photo credit: Durham Technical Community College/Julie Hoover



A Swarmie robot finds a “resource” cube marked with an AprilTag. In the Swarmathon competition, students were asked to develop computer code for the small robots, programming them to look for “resources” in the form of cubes with AprilTags. Photo credit: NASA/Kim Shiflett

year’s event. The program is supported by the Wallops **Balloon Program Office** and the **Louisiana Space Consortium** at Louisiana State University.

“Our team built a robotic arm to perform tasks at 121,000 feet (23 miles) in the atmosphere,” said Koris, who has since graduated from Durham Tech and now is studying computer science at the University of Colorado-Boulder.

The group developed a device called Robotic Arm Manipulation and Materials Matching, or RAM3. They built and programmed a robotic arm to perform basic kinetic tasks such as turning knobs and pushing buttons, as well as sealing and unsealing a Velcro strip.

For several years, engineers at Kennedy and NASA’s Goddard Space Flight Center in Greenbelt, Maryland, have been developing similar **robotic satellite servicing technologies** necessary to bring in-orbit inspection, repair, refueling and component replacement capabilities to Earth-orbiting spacecraft needing aid.

NASA’s HASP balloon launched on Sept. 4, 2018, from the **Columbia Scientific Balloon Facility** in Palestine, Texas. The Durham Tech team was able to follow RAM3’s progress with an on-board television camera.

“Watching our robotic arm move while more than 100,000 feet off the ground was amazing,” Murray said.

During the flight, the team allowed followers to monitor their progress with a Facebook blog.

“We’re flipping switches and turning knobs at 120,000 feet,” their post stated. “The HASP gondola has reached float altitude. RAM3 is still turning knobs and performing brilliantly.”

After the successful flight of RAM3, Koris also thanked those who led Kennedy’s Swarmathon effort, believing that experience helped with their HASP effort.

“Know that you are a part of this,” he said. “So, a huge thanks to your team!”

In a laboratory at Durham Technical Community College, software engineer Soham Pai Kane develops code for the team’s Swarmathon rovers. Through the Swarmathon, students gain experience with code integration, hardware testing, software engineering, project management and team collaboration critical to their future success in robotics and computer science. Photo credit: Durham Technical Community College/Meredith Murray

Island Enthusiasm

Puerto Rican students, educators, eagerly engage in NASA STEM Program

BY JIM CAWLEY

A recent trip to Puerto Rico to foster interest in STEM (science, technology, engineering, math), and to spark enthusiasm for NASA, showed six Kennedy Space Center employees that the passion for education — and the agency — is very much alive on the Caribbean island.

“Everybody across the island wanted to come; they wanted the information,” said Priscilla Moore, a lead program specialist for the Communication and Public Engagement (PX) Education Projects and Youth Engagement Office. “It was so heartwarming.”

Moore was accompanied on the late August 2018 trip by Theresa Martinez, PX education program specialist; Pablo Aguayo and Jose Lopez from the Engineering Directorate; Greg Clements from **Exploration Research and Technology Programs** and Richard Rodriguez from the Diversity and Equal Opportunity Directorate. The “NASA Days, Condensed” Program involved presentations, robotic team demonstrations, facility tours — including teaching labs established through NASA grants a decade ago — and one-on-one discussions with students, teachers and administrators.

The Kennedy group was able to reach more than 700 students, covering five universities throughout Puerto Rico in four days. The ambitious schedule included visits to: Polytechnic University of Puerto Rico, Hato Rey; University of Puerto Rico, Arecibo Campus; Inter American University, Arecibo Campus; University of Turabo, Ponce Campus; and Inter American University San Juan, Faculty of Law.

Kennedy employees weren’t the only ones who logged significant miles to be a part of the program.

“It was amazing to know that some highly motivated students drove as much as 2 hours to be at this event,” Martinez said. “The students were eager to hear what we had to say and excited to chat with us after the sessions.”

Aguayo, Lopez, Martinez and Rodriguez all hail from Puerto Rico. That was a distinct advantage, said Clements, who observed how significantly it resonated with the students.

“It was an honor to be able to go to my country of origin and speak to STEM students,” Aguayo said. “I was very impressed with the enthusiasm that the university directors, educators and students showed toward having this opportunity to have NASA engineers speaking to them.”

Just a year removed from the devastating Hurricane Maria striking their island, Puerto Ricans displayed resiliency and optimism in their desire to keep progressing, Clements said. He also noted that local government and chamber of commerce officials were united in their support of NASA, striving to grow their technical base on the island.

Jeannette Vázquez, CEO & president, Creative Skills Enterprises Inc., third from the left, is accompanied by NASA Kennedy Space Center employees. From left to right are Jose Lopez, Pablo Aguayo, Richard Rodriguez, Priscilla Moore, Theresa Martinez and Greg Clements at Polytechnic University of Puerto Rico. Vázquez worked with schools in Puerto Rico to coordinate the visit by Kennedy employees, who were promoting STEM studies and generating enthusiasm for NASA. Photo credit: NASA

“They have had to overcome a lot of adversity in recent months,” Clements said, “but everyone I spoke to was not frowning about the past — they were looking toward the future. They want to see Puerto Rico move forward in a renewed way.”

The “NASA Days” concept was developed by PX Deputy Director **Hortense Diggs** in 2010. It focuses on encouraging students at minority serving institutions to study STEM and pursue a career with NASA. Clements, who has attended many of these trips, relishes every opportunity he gets to interact with eager students. It’s a stark reminder of his own experience when he was a student at Georgia Tech more than 30 years ago.

“I feel so blessed because NASA really reached out to our school and encouraged us, and I want to pay it forward to get more people plugged into NASA,” Clements said. “As long as PX will give me the honor and opportunity, I’m going to try to contribute.”

Clements knows that a small contribution he makes now, could pay huge dividends one day for NASA — and for mankind.

“We need sharp minds, all kinds of people, to help make the space program successful in the future,” he said. “Students I visit now may be the ones who help guide our missions to the Moon and Mars.”

“A Magnificent Flying Machine”

‘’Apollo 7 launched as race to Moon reached final stretch

BY BOB GRANATH

On Oct. 11, 1968, three American astronauts launched to Earth orbit aboard **Apollo 7**. It was the first piloted mission of the spacecraft designed to meet President John F. Kennedy’s challenge to land on the lunar surface.

The 11-day flight took place as the race to the Moon was heating up between the United States and the Soviet Union. A month earlier, the Soviets launched the unpiloted Zond 5, a simplified version of their **Soyuz** spacecraft designed for cosmonauts. The capsule became the first to circle around the Moon and return safely to Earth.

Both nations also were recovering from tragic losses. Three **Apollo 1** astronauts perished in a launch pad fire on Jan. 27, 1967. That same year, the lone cosmonaut aboard **Soyuz 1** died when the spacecraft crashed on April 24.

Following almost two years of **Apollo** spacecraft redesign and testing, Paul Donnelly, Launch Operations manager at NASA’s Kennedy Space Center in Florida, expressed confidence in the men and women who worked tirelessly to prepare for the flight.

“We have a great group of specialists from government and industry trained to work as a team,” he said. “Just as the astronauts are ready to fly to orbit, we are ready to get them there.”

Serving as commander of Apollo 7 was NASA veteran Wally Schirra, a U.S. Navy aviator and captain. He flew **Mercury 8** on Oct. 3, 1962, and commanded **Gemini VI** on Dec. 15-16, 1965.

Schirra was joined by two members of the third astronaut class, both making their first spaceflight. Command module pilot Donn Eisele was a U.S. Air Force colonel and test pilot. Walt Cunningham had been a colonel and fighter pilot in the U.S. Marine Corps Reserve. Although there was no lunar module (LM) on this flight, as the third member of the crew, Cunningham was designated LM pilot.

During liftoff on Oct. 11, 1968, the Apollo 7 Saturn 1B rocket is photographed more than 35,000 feet above the Atlantic Ocean from a C-135 aircraft using an Airborne Lightweight Optical Tracking System. Photo credit: NASA

Photographed during training on May 22, 1968, the Apollo 7 crew pose at the hatch of their spacecraft. From left are command module pilot Donn Eisele, commander Wally Schirra and lunar module pilot Walt Cunningham. Installation of a quick-opening hatch mechanism was one of the crucial improvements added after the loss of the Apollo 1 crew. Photo credit: NASA

Following launch, the Apollo 7 crew photographed the expended Saturn launch vehicle's second stage, called the S-IVB. NASA's Kennedy Space Center and Cape Kennedy (now Cape Canaveral) Air Force Station are visible on the lower left. The round, white disc inside the open panels of the S-IVB is a simulated docking target similar to that used for docking with a lunar module. Photo credit: NASA

NASA Marks the Legacy of Apollo

From October 2018 through December 2022, NASA is marking the 50th anniversary of the 11 piloted Apollo missions that included landing a dozen Americans on the Moon between July 1969 and December 1972. Today, NASA is working to return astronauts to the Moon to test technologies and techniques for the next giant leaps – challenging missions to Mars and other destinations in deep space. Image credit: NASA

Following a flawless liftoff atop a Saturn 1B rocket from Launch Complex 34 at Cape Kennedy (now Cape Canaveral) Air Force Station, the command-service module (CSM) separated from the second stage. Eisele then practiced a simulated LM docking. During launch with a LM, it would have been housed inside the adapter between the second stage and the CSM.

A key objective of Apollo 7 was testing spacecraft systems, especially the crucial service propulsion system (SPS) engine at the base of the spacecraft. On lunar missions, the SPS would be used to place the spacecraft in lunar orbit and later, fire the crew on a trajectory back home. On Earth orbital flights, the SPS would be fired to slow Apollo for re-entry.

The first test of the powerful SPS took place on flight day two. When it fired with 20,500 pounds of thrust, Schirra radioed that it was a real kick.

"Yabbadabbadoo," he exclaimed in a favorite saying of the television cartoon character Fred Flintstone. "That's like a ride and a half!"

George Low, manager of the Apollo Spacecraft Program Office at NASA's Manned Spacecraft Center (now Johnson Space Center) in Houston, later noted that all eight firings of the SPS went extremely well.

"We had a tremendous workout of the service propulsion system," he said. "I believe that is more than any space propulsion system has ever been used in any one flight"

Another goal was broadcasting live television from the spacecraft. Three days after liftoff, the Apollo 7 camera was turned on, allowing Mission Control and viewers around the world to watch the crew in orbit.

"I can see Eisele there," said spacecraft communicator Tom Stafford, a fellow astronaut. "He's holding a sign and it says, 'From the lovely Apollo room, high atop everything.' "

The crew fired the SPS engine on Oct 22, splashing down in the Atlantic Ocean eight miles from the recovery aircraft carrier, the USS Essex.

After the flight, Schirra described the Apollo CSM as "a magnificent flying machine."

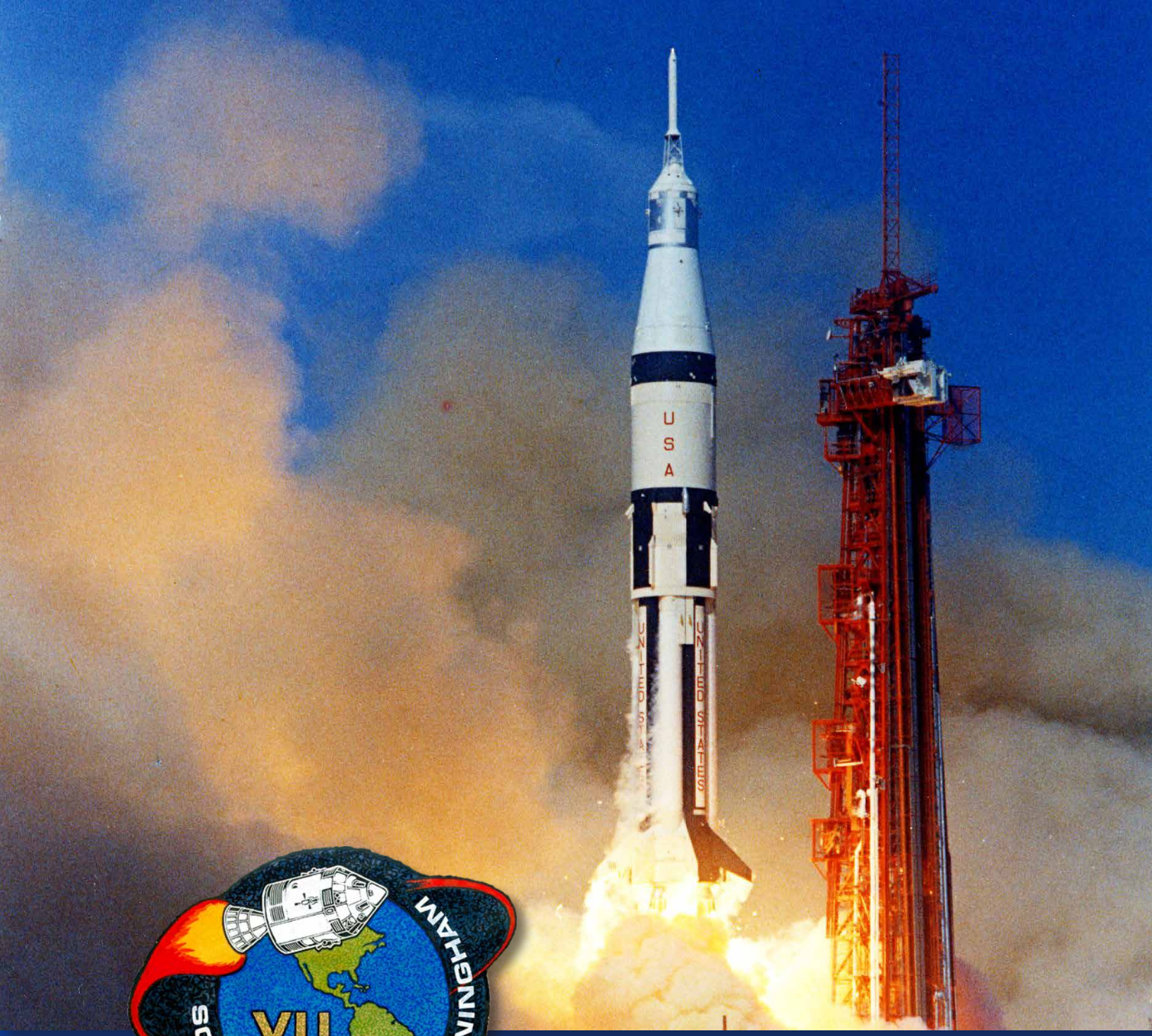
Lt. Gen. Samuel Phillips, director of NASA's Apollo Program Office, considered Apollo 7 a perfect mission.

"We were able to accomplish a major step in our progress toward the lunar landing," he said. "I have every confidence that the progress of this mission will let us accomplish that by the end of next year."

(Left) During the first television broadcast, Apollo 7 commander Wally Schirra, right, displays a message for viewers on Earth as command module pilot Donn Eisele looks on. Photo credit: NASA Television

(Below) Apollo 7 lunar module pilot Walt Cunningham is making notes about subjects photographed on the film cartridge floating above his hand. Photo credit: NASA

For more information about NASA's plan for the future, visit: **NASA Exploration: Back to the Moon and On to Mars**



Apollo 7 lifts off from Cape Kennedy (now Cape Canaveral) Air Force Station's Launch Complex 34 on Oct. 11, 1968. It was the first of several piloted flights designed to qualify the spacecraft for the half-million-mile round trip to the Moon. Photo credit: NASA

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