

KENNEDY SPACE CENTER'S SPACEPORT m a g a z i n e



Vice President Tours Space Center

Kennedy Space Center's
SPACEPORT MAGAZINE
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COVER: Vice President Mike Pence, center, is flanked by NASA astronauts Reid Wiseman and Pat Forrester as they walk out through the same door used by Apollo and space shuttle flight crews departing for the launch pad. Pence toured the Neil Armstrong Operations and Checkout Building at Kennedy Space Center on July 6, where the Orion spacecraft is being readied for a trip beyond the Moon on its first integrated flight with the Space Launch System rocket. During his visit to Kennedy, Pence spoke inside the Vehicle Assembly Building, where he thanked employees for advancing American leadership in space. The vice president also toured several facilities highlighting the public-private partnerships at Kennedy, as both NASA and commercial companies prepare to launch American astronauts from the multi-user spaceport. Photo credit: NASA/Kim Shiflett

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NASA'S
LAUNCH
SCHEDULE

Targeted Date: Aug. 13
Mission: SpaceX CRS-12
Description: SpaceX will launch its 12th commercial resupply services mission for NASA to the International Space Station from Launch Pad 39A at Kennedy Space Center. The Dragon spacecraft, packed with several tons of supplies, including new science experiments and technology research, will launch atop the Falcon 9 rocket.
<https://go.nasa.gov/2uu2Cwt>

Date: August
Mission: Tracking and Data Relay Satellite-M (TDRS-M)
Description: Orbiting 22,300 miles above Earth, the TDRS spacecraft provide near-constant communication links between the ground and orbiting satellites, such as Hubble and the International Space Station. TDRS-M will launch from NASA's Kennedy Space Center in Cape Canaveral, Florida, on a United Launch Alliance Atlas V rocket.
<http://go.nasa.gov/2l8Hysg>

Date: September
Mission: Joint Polar Satellite System-1 (JPSS-1)
Description: JPSS is a next-generation environmental satellite system. It is a collaborative program between the National Oceanic and Atmospheric Administration (NOAA) and NASA. The polar-orbiting weather satellite will launch from Vandenberg Air Force Base in California on a United Launch Alliance Delta II rocket.
<https://go.nasa.gov/2rW4DCf>

Date: September
Mission: Expedition 53 Launch
Description: NASA astronauts Joe Acaba and Mark Vande Hei and cosmonaut Alexander Misurkin of the Russian space agency Roscosmos will launch to the International Space Station aboard the Soyuz MS-06 spacecraft from the Baikonur Cosmodrome in Kazakhstan.
<https://go.nasa.gov/2rkRChR>

Date: Nov. 14
Mission: Ionospheric Connection Explorer (ICON)
Description: The Ionospheric Connection Explorer will study the frontier of space, the dynamic zone high in our atmosphere where Earth weather and space weather meet. ICON will launch from Kwajalein Atoll aboard an Orbital ATK Pegasus XL.
<https://www.nasa.gov/icon>

Want to see a launch?
The Kennedy Space Center Visitor Complex offers the closest public viewing of launches from Kennedy Space Center and Cape Canaveral Air Force Station. Launch Transportation Tickets are available for some, but not all, of these launches. Call **321-449-4444** for information on purchasing tickets.

SCENE @ KENNEDY SPACE CENTER



A snowy egret balances on branches near the shoreline at Kennedy Space Center in Florida. Photo credit: NASA/Glenn Benson

AMERICAN MADE



Vice President Mike Pence speaks before an audience of NASA leaders, U.S. and Florida government officials, and employees inside the Vehicle Assembly Building at NASA's Kennedy Space Center in Florida. Photo credit: NASA/Kim Shiflett

Reinvigorated center greets Vice President Pence

BY STEVEN SICELOFF

Vice President Mike Pence on Thursday, July 6, saw a Florida spaceport poised in the starting blocks to return America's human launch capability, begin a new era in deep space exploration and capitalize on emerging partnerships with private industry.

Driving through much of the launch and processing facilities spread throughout the 144,000 acres of NASA's Kennedy Space Center, Pence saw launch pads rebuilt for the needs of privately operated rockets, former space shuttle hangars refit to serve as spacecraft factories and the assembly hall for NASA's own deep space exploration spacecraft, Orion.

Former astronaut Bob Cabana, Kennedy's center director, guided the tour for Pence who was making his first stop at the center since becoming vice president. As vice president, Pence will serve as chairman of the newly reformed National Space Council that will

set goals and establish policies for the United States' space efforts.

"When you look back in all of human history, only three nations have sent humans into orbit," Cabana told community leaders recently. "Now, across Kennedy Space Center, there are four American companies building hardware and infrastructure to send humans into orbit: Lockheed Martin, SpaceX, Boeing and Blue Origin. That's pretty amazing. When we look at the transition, we have an outstanding future and we have a great plan put into place."

Remade from a center focused heavily on the government-run Space Shuttle Program, Kennedy now favors flexibility in its operations and infrastructure. The center has become more accustomed to opening its unique laboratory, processing and launch capabilities to private companies that would not have had the chance to use them before.



Vice President Mike Pence, center, and U.S. Senator Marco Rubio, left, examine flight hardware during a tour of the Neil Armstrong Operations and Checkout Building at NASA's Kennedy Space Center in Florida, where the Orion spacecraft is being readied for a trip beyond the Moon on its first integrated flight with the Space Launch System rocket. Photo credit: NASA/Kim Shiflett

Practically every location Pence toured showed significant changes from what it had been. The inside of the Vehicle Assembly Building, where Pence spoke to part of the center's workforce, continues to see installations that will allow it to host the stacking of the massive Space Launch System rocket, a behemoth more than 32 stories tall designed to launch astronauts far beyond Earth orbit on missions that will eventually include destinations past the Moon and on to Mars. Unlike previous structures placed inside the VAB that were set up for one launch configuration only, the new platforms can be moved around and pieces replaced more easily to host many different arrangements of the SLS rocket. That gives mission planners more flexibility and allows the rocket to take the form best for the spacecraft it is launching.

The spacecraft in development for those deep space missions, called Orion, is deep into its own manufacturing inside the Neil Armstrong Operations and Checkout Building in Kennedy's industrial area ahead of a 2019 flight that will see it launch atop an SLS rocket and orbit the Moon without a crew aboard.

Assembly is taking place in the same high bay that saw numerous spacecraft and modules come together and get tested before making their own historical trips. Orion, however, is much larger than those that came before and full of cutting-edge technology so astronauts

can safely make their exploratory flights to broaden humanity's knowledge of the worlds around our own. The high bay itself also is thoroughly modernized and shares little with its previous form aside from its shape.

While Orion has been designed by NASA and built by Lockheed Martin for future missions taking astronauts from Florida's shores to the reaches of distant worlds, Pence also was shown the spacecraft, launch and mission facilities that will mark America's return to human launch capability as soon as next year.

Working in close partnership with NASA's Commercial Crew Program in a process new to human spacecraft development, Boeing and SpaceX are making independent spacecraft and launch systems to take astronauts to the International Space Station from America. Boeing is building a line of Starliner spacecraft and SpaceX is making a crewed version of its Dragon spacecraft. Both spacecraft, along with their launch vehicles, mission and launch control systems, are being certified by NASA for safety, reliability and cost-effectiveness.

Seen together, the transformation of the center shows the form of a spaceport that has embraced the potential of new partnership approaches while holding onto its heritage of success and broadening the range of exploration for the nation.

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A solar eclipse occurs when the Moon passes between the Sun and the Earth, casting its shadow on the Earth. The shadow comprises two concentric cones called the umbra and the penumbra. Observers within the smaller, central umbra see the Sun completely blocked. Within the larger penumbra, the Sun is only partially blocked. Image credit: NASA's Scientific Visualization Studio

ROAD TRIP TO TOTALITY

Kennedy team to share expertise with eclipse viewers in Charleston

BY ANNA HEINEY

A total solar eclipse will darken skies across the country Aug. 21 -- and education specialists at NASA's Kennedy Space Center in Florida are teaming up with a host of other agency resources to make this rare celestial treat a fun and memorable learning experience for eclipse viewers in Charleston, South Carolina.

A team of experts in spaceflight, education and outreach will travel from the Florida spaceport to Charleston for hands-on demonstrations and education about the eclipse, with special emphasis on how to view it safely.

"With live presentations and question-and-answer sessions, we'll get the chance to dispel any myths or misunderstandings about the eclipse, and make sure the public gets the most correct and up-to-date information," said Denise Coleman, an education program specialist in the NASA Education Project and Youth Engagement Office at Kennedy.

During the eclipse, the Moon will pass between Earth and the midafternoon Sun, casting a moving shadow on the landscape below. The 70-mile-wide totality path, or "umbral cone" -- where the entire Sun will vanish behind the Moon -- stretches across 14 states, from Oregon to South Carolina.

Charleston, South Carolina, is the final large city along the totality path, and NASA will be there to participate in several eclipse-related events that are open to the public. The Goddard Education Office, from the agency's Goddard Space Flight Center in Greenbelt, Maryland, led the planning effort and also will take the lead on putting these plans into action, and Kennedy is playing an important role.

Coleman leads the Kennedy team participating in NASA's eclipse activities in Charleston. The group includes education specialists, media specialists, and representatives from the Launch Services Program, or LSP, and Ground Systems Development and Operations Program, or GSDO, both of which are based at Kennedy.

On Saturday, Aug. 19, educators and staff will provide demonstrations and hands-on activities three times during the day at the Charleston Museum, Charleston Library and Charleston Aquarium.

During the eclipse, solar missions such as NASA's Solar Dynamics Observatory, Interface Region Imaging Spectrograph, and Solar Terrestrial Relations Observatory, along with the ESA/NASA Solar and Heliospheric Observatory and the JAXA/NASA Hinode, will capture data, while NASA's Lunar Reconnaissance Orbiter will take pictures of the Moon's shadow on Earth.

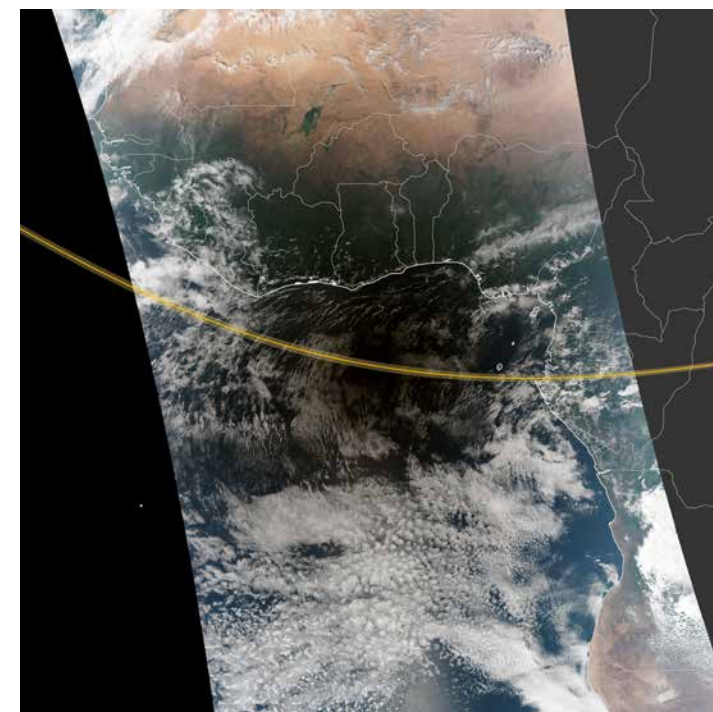
Subject-matter experts from LSP and GSDO will be present on the USS Yorktown at Patriots Point, where they'll share their passion

and enthusiasm about these missions and about how Kennedy is preparing for the next chapter in spaceflight. The USS Yorktown has a special significance to NASA: It plucked the Apollo 8 astronauts from the sea after their successful mission in December 1968.

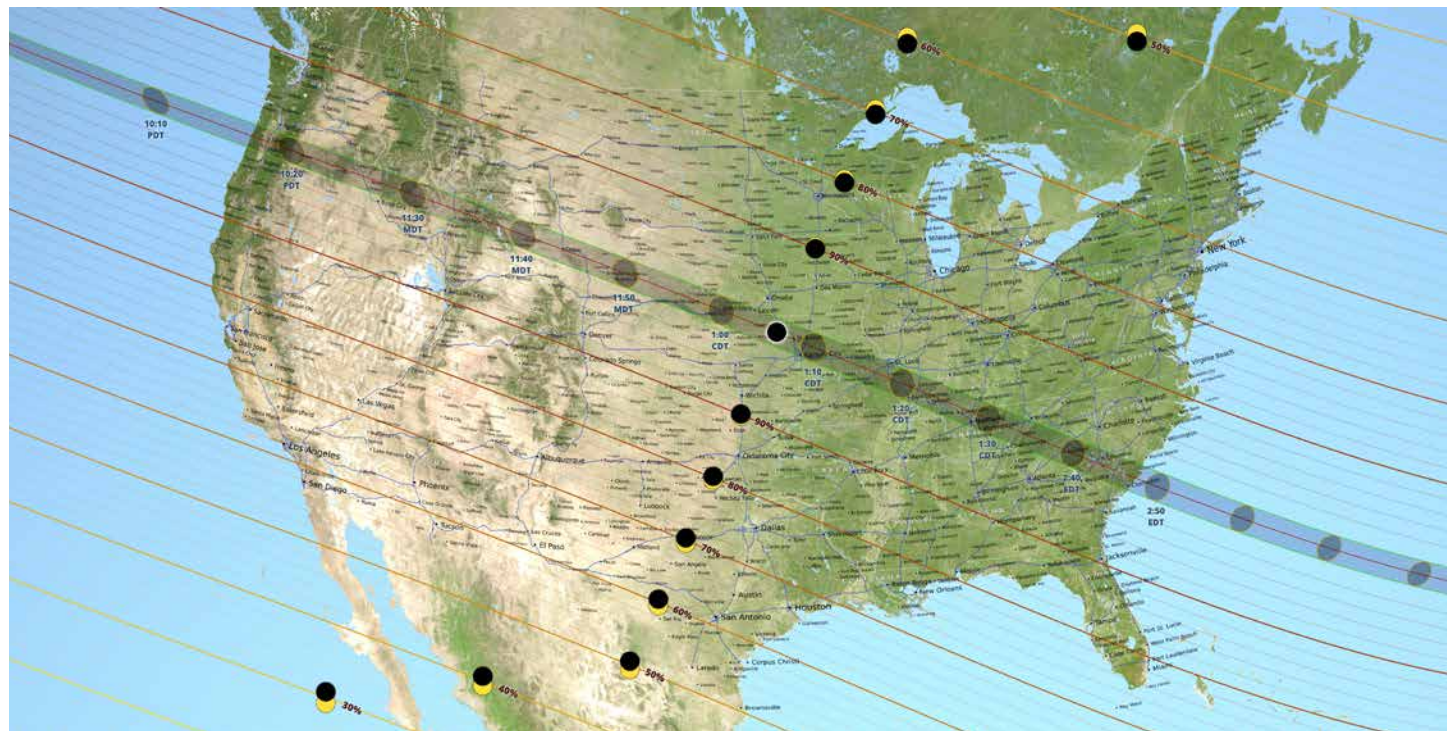
NASA Space Grant universities and colleges across the country are releasing high-altitude balloons carrying GoPro cameras to capture video of the umbral cone and feed these views to NASA TV. Kennedy is supporting the Puerto Rico University team, launching at about 1:47 p.m. EDT from the Riverdogs Stadium in Charleston. Kennedy's Digital Learning Network also will run a program tied into NASA TV. The site opens at 1 p.m. Gates open at 1 p.m.

Events are open to the public, but space is limited. "The biggest challenge will be to provide meaningful interactions with the huge audiences we're expecting," Coleman said. "We anticipate meeting 2,000-3,000 guests across these locations on Saturday, Aug. 19, and another 15,000-16,000 people total at three venues on the day of the eclipse."

Many parts of the globe outside the totality path -- including all of North America -- will experience a partial eclipse. Back home



During this 2013 hybrid eclipse, the Moon blocked just part of the Sun -- an annular eclipse -- at sunrise in the western Atlantic Ocean, then moved into total eclipse along a long, narrow path crossing into central Africa. This photo was taken by the Visible Infrared Imaging Radiometer Suite (VIIRS) on the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite. The yellow line shows the path of the total eclipse. Image credit: NASA Earth Observatory/Robert Simmon and Jesse Allen



This map of the United States shows the path of the Moon's umbral shadow — the path of totality — during the total solar eclipse on Aug. 21, 2017, as well as the obscuration (the fraction of the Sun's area covered by the Moon) in regions outside the umbral path. Image credit: NASA's Scientific Visualization Studio

at Kennedy Space Center, more than 85 percent of the Sun will be hidden by the Moon; in New York City, about 70 percent; Los Angeles, 62 percent; Anchorage, Alaska, about 45 percent. (Find out what you'll see - and what time - with NASA's eclipse maps.)

Follow along with NASA TV and livestreams from all around the country at <http://www.nasa.gov/eclipselive>. To join up with others in your area, find eclipse activities near you.

Kennedy's education team didn't want to wait until August to share the eclipse with teachers and students, so they've been sharing it whenever they can, incorporating it into teacher workshops and outreach events throughout the summer.

With the eclipse only a few weeks away, the Kennedy team is finalizing its plans. In vans full of banners, displays and demonstration supplies, the team will hit the road for Charleston on Friday, Aug. 18, kicking off a whirlwind weekend of science and fun.

"We'll get to share the NASA story with all of those guests," Coleman said, "We get to share how NASA science benefits everyone, and hopefully spark an interest in a young audience member to be drawn into a career in science, technology, engineering or math."

Plus, she added, "you can't beat that we'll be in the path of totality and will be the last site to view the 2017 eclipse from U.S. soil."

ECLIPSE VIEWING SAFETY

Warning: Looking directly at the Sun is unsafe except for the brief total phase of the solar eclipse (totality) when the Moon entirely blocks the Sun's bright face, which will only happen within the narrow path of totality. Florida will not be in this path, so there will be no safe time to look directly at the Sun with unprotected eyes during the eclipse.

There are many ways to look at the eclipse through indirect methods. However, the only safe way to look directly at the uneclipsed or partially eclipsed Sun is through special-purpose solar filters, such as eclipse glasses or hand-held solar viewers. NASA recommends checking your glasses ahead of time to make sure they meet the safety standards listed at <http://eclipse2017.nasa.gov/safety>.

For more information on the 2017 eclipse, visit <http://eclipse2017.nasa.gov>.



This photo of a total solar eclipse was taken in the South Pacific on July 11, 2010. Photo credits: Williams College Eclipse Expedition/Jay M. Pasachoff, Muzhou Lu and Craig Malamut

READY TO RUMBLE

New supersonic technology designed to reduce sonic booms

BY BOB GRANATH



Residents along Florida's Space Coast will soon hear a familiar sound -- sonic booms. But instead of announcing a spacecraft's return from space, they may herald a new era in faster air travel.

NASA's Kennedy Space Center in Florida is partnering with the agency's Armstrong Flight Research Center in California, Langley Research Center in Virginia, and Space Florida for a program called Sonic Booms in Atmospheric Turbulence, or SonicBAT II. Starting in mid-August, NASA F-18 jets will take off from the Shuttle Landing Facility (SLF) and fly at supersonic speeds while agency researchers on the ground measure the effects of low-altitude turbulence on sonic booms.

This illustration depicts NASA's planned Low Boom Flight Demonstration aircraft. The agency and Lockheed Martin have just completed the preliminary design of the Quiet Supersonic Transport, or QueSST, aircraft studying the shape and position of aircraft components, along with the propulsion system, to determine what factors contribute to an aircraft's sonic boom. Photo credit: NASA/Lockheed Martin



Aircraft such as NASA's F-18 will soon fly along Florida's Space Coast testing innovative technology with the possibility of reducing the level of annoying sonic booms associated with flight faster than the speed of sound. Photo credit: NASA

The project is another example of Kennedy's role as a premier, multi-user spaceport. In 2015, the center signed a 30-year property agreement with Space Florida for the operations and management of the SLE. This partnership provides an avenue for a variety of commercial and government partners to have access to use the three-mile-long runway.

According to John Graves of NASA Flight Operations in Kennedy's Spaceport Integration and Services, for projects such as SonicBAT, NASA coordinates with Space Florida who manages the facility's schedule.

"Working with representatives from the Armstrong center, we go through Space Florida to request use of the runway," he said. "It's an arrangement that works very well."

The F-18 will begin flights on Aug. 21, flying two to four times a day over a period of 10 days. But the actual test window may be two weeks to allow for weather and other possible delays.

Graves explains that SonicBAT is an unusual test in that it uses a typical military aircraft with its loud sonic boom to help engineers better understand the sounds from future quiet supersonic aircraft.

"We're hoping we can eventually lower sonic booms to a low rumble," he said. "The goal is to eventually accommodate jets that can fly from New York to Los Angeles in two hours."

Armstrong started SonicBAT investigations at Edwards Air Force Base last year. This will be the second round of tests.

"Edwards is a hot, dry environment," he said. "The team at the Armstrong center wants to now try to collect similar data in the hot, humid climate we have here."

The problem is sonic booms are bothersome, loud, thunder-like sounds occurring when an aircraft or other aerospace vehicle flies overhead faster than the speed of sound -- about 767 mph. U.S. Air Force pilot Chuck Yeager was the first to break the sound barrier on Oct. 14, 1947, at Muroc (now Edwards) Air Force Base in California.

Throughout the 1950s and 1960s, sonic booms became a familiar part of American life as military jets became faster and

faster. At the time, it seemed that supersonic passenger air travel was on the near horizon. However, the boom created by shock waves, or rapid changes in pressure that occur at supersonic speeds, disturbed people and occasionally caused property damage when military aircraft flew at very low altitudes. Consequently, such flights currently are restricted by the Federal Aviation Administration, except for craft such as the now-retired space shuttle, SpaceX Falcon 9 first stages and the X-37B Orbital Test Vehicle.

"For the upcoming tests, F-18 jets will fly offshore from Daytona at about 41,000 feet," Graves said. "They will fly south, diving down below to around 32,000 feet and accelerating to supersonic speeds to create a sonic boom that will reach the ground where the test equipment is located."

There will be a small motorized glider which can fly with its engine off positioned above the 14,000-foot level to measure sonic booms above the turbulent layer, and microphone sensors set up north and south of Launch Complex 39B.

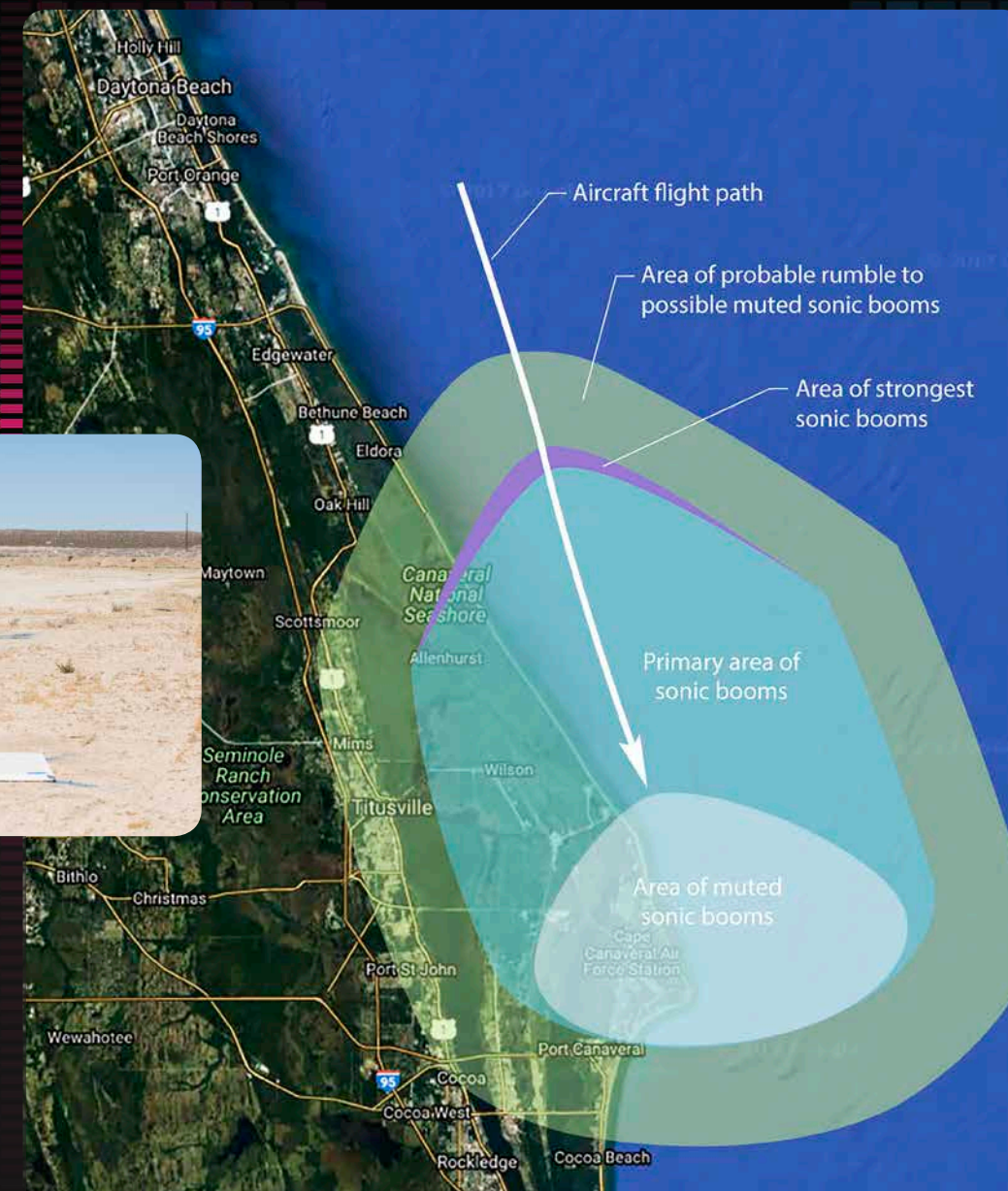
With this data, and building on previous supersonic research, NASA hopes to develop cutting-edge tools and technologies for the design of future "low boom" aircraft reducing or almost eliminating the noise.

The ongoing research goes beyond SonicBAT. NASA and partners in U.S. industry and universities are testing a variety of factors that may make supersonic passenger travel a reality. The next exciting step will be the development of experimental aircraft that can demonstrate low-boom flight. NASA and Lockheed Martin have just completed the preliminary design of the Quiet Supersonic Transport, or QueSST, aircraft studying the shape and position of aircraft components, along with the propulsion system to determine what factors contribute to an aircraft's sonic boom.

In the next phase of this effort, NASA will partner with U.S. industry to build the Low Boom Flight Demonstrator, an experimental aircraft that, when flying at supersonic speeds, will create a soft "thump" instead of the disruptive sonic boom.



One of three microphone arrays positioned strategically along the ground at Edwards Air Force Base, California, sits ready to collect sound signatures from sonic booms created by a NASA F-18 during the SonicBAT flight series. Similar arrays will be set up near NASA's Kennedy Space Center to collect the sound signatures of booms that have traveled through atmospheric turbulence before reaching the ground. Photo credit: NASA/Lauren Hughes



NASA's F-18 will fly at or above 32,000 feet when it goes supersonic off the eastern coast of Florida. The F-18's flightpath is positioned in efforts to keep the strongest-sounding sonic booms away from residential areas, while still producing sonic booms over the Kennedy Space Center where the sonic boom sound will be collected by microphone arrays on the ground. While sonic booms will be more audible on the beaches north of Kennedy, Cape Canaveral Air Force Station will hear "muted," or quieter, sonic booms. Areas including Scottsmeer, Mims, Titusville, Port St. John, Cocoa and Port Canaveral are likely to hear a sound closer to the rumble of distant thunder, though people may hear an occasional "muted" sonic boom. Photo credit: NASA



When the Dragon arrives at the International Space Station, NASA astronauts Jack Fischer and Peggy Whitson will grapple the spacecraft using the station's robotic arm and install it on the station's Harmony module. Dragon will deliver almost 6,000 pounds of supplies and payloads, including materials to support more than 250 science and research investigations during Expeditions 52 and 53. Photo credit: NASA

RESUPPLY READIED

Dragon packed with new experiments for International Space Station

BY BOB GRANATH

The International Space Station is a unique scientific platform enabling researchers from around the world to develop experiments that could not be performed on Earth. A line of uncrewed resupply spacecraft keeps this work going, supporting efforts to enable future human and robotic exploration of destinations well beyond low-Earth orbit.

The next mission to the space station will be the 12th commercial resupply services flight for SpaceX. Liftoff is targeted for Aug. 13 at approximately 12:56 p.m., from Launch Complex 39A at NASA's Kennedy Space Center in Florida. This underscores the center's role as a premier, multi-user spaceport as this will be the ninth SpaceX rocket to take off from the launch pad, all this year. Pad 39A's history includes 11 Apollo flights, the launch of the Skylab space station in 1973, and 82 space shuttle missions.

A SpaceX Falcon 9 rocket will boost a Dragon capsule filled with almost 6,000 pounds of supplies. The payloads include crucial

materials to directly support dozens of the more than 250 science and research investigations that will occur during Expeditions 52 and 53.

About 10 minutes after launch, Dragon will reach its preliminary orbit and deploy its solar arrays. A carefully choreographed series of thruster firings are scheduled to allow the spacecraft to rendezvous with the space station. NASA astronauts Jack Fischer and Peggy Whitson will grapple Dragon using the space station's robotic arm and install it on the station's Harmony module.

The station crew will unpack the Dragon and begin working with the experiments that include plant pillows containing seeds for NASA's Veggie plant growth system experiment. The plant pillows were prepared in Kennedy's Space Station Processing Facility.

Veggie, like most of the research taking place on the space station, is demonstrating how the research benefits life on Earth as it advances NASA's plans to send humans to Mars.



Technicians and engineers inspect the Cosmic-Ray Energetics and Mass investigation, or CREAM, instrument in the Space Station Processing Facility at Kennedy Space Center. Photo credit: NASA/Leif Heimbolt

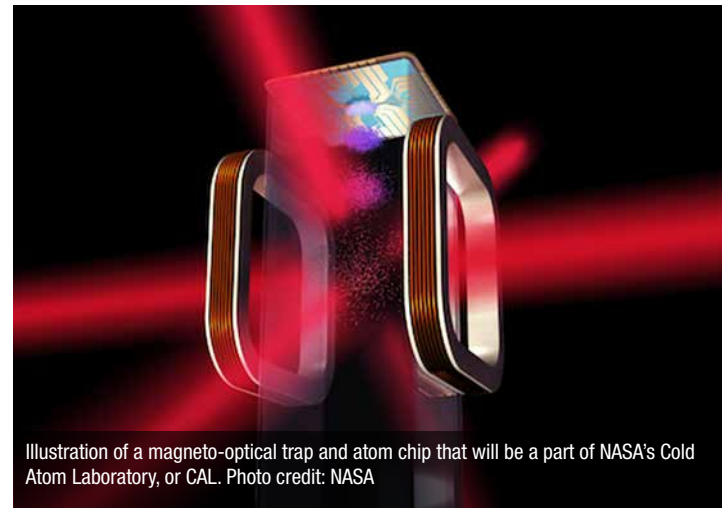


Illustration of a magneto-optical trap and atom chip that will be a part of NASA's Cold Atom Laboratory, or CAL. Photo credit: NASA

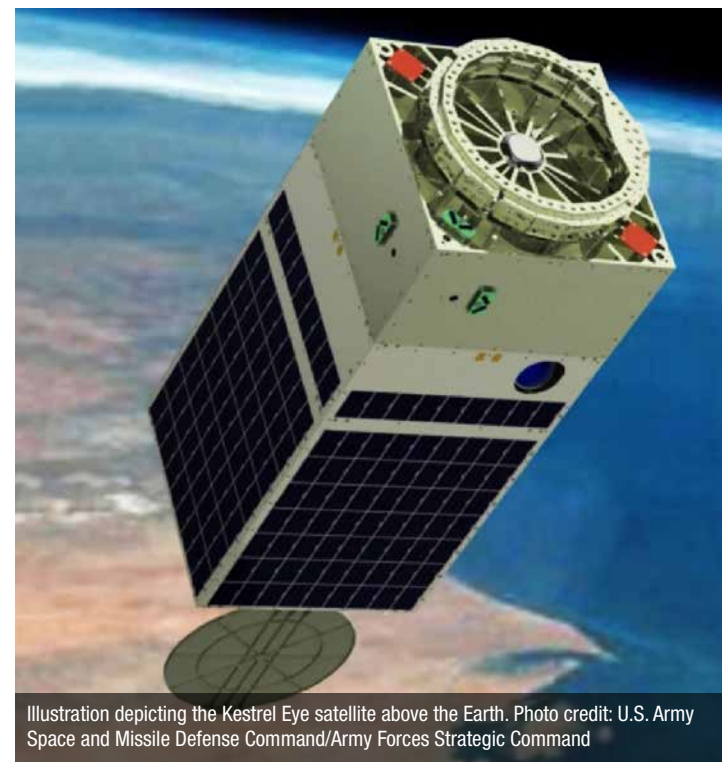


Illustration depicting the Kestrel Eye satellite above the Earth. Photo credit: U.S. Army Space and Missile Defense Command/Army Forces Strategic Command

Cosmic-Ray Energetics and Mass

The one instrument secured to the unpressurized bottom of the Dragon spacecraft is the Cosmic-Ray Energetics and Mass, or CREAM, investigation. For many years, the instrument was a highly successful balloon-borne instrument. It now will be aboard the space station and placed outside the Japanese Exposed Module for at least three years.

CREAM's instruments are designed to measure the charges of cosmic rays over a broad energy range. Compared to atmospheric balloon flights, CREAM will gather ten times more data, which will have lower background interference because Earth's atmosphere is no longer interfering.

Cold Atom Laboratory

The Cold Atom Laboratory, or CAL, is a collection of instruments carried aboard the Dragon spacecraft with a goal of creating the coolest spot in the universe. Developed by NASA's Jet Propulsion Laboratory in Pasadena, California, CAL is an ice chest-sized box with lasers, a vacuum chamber and an electromagnetic "knife" to be used to cancel out the energy of gas particles, slowing them until they are almost motionless.

CAL's instruments are designed to freeze gas atoms to a billionth of a degree above absolute zero, the lowest temperature that is theoretically possible. It is hoped that studying hyper-cold atoms would reshape scientists' understanding of matter and the fundamental nature of gravity.

Kestrel Eye

The Kestrel Eye satellite is an investigation sponsored by the National Laboratory of the Department of Defense. It is a small satellite with an optical imaging system, including a Commercial Orbital Transportation System telescope. It will be deployed into orbit from the airlock of the station's Japanese Experiment Module.

The overall goal is to demonstrate the concept that small satellites in low-Earth orbit are viable platforms to provide lower-cost, rapidly visible, Earth imagery in support of time-sensitive operations, such as tracking severe weather and detecting natural disasters.

The Dragon spacecraft will spend approximately one month attached to the space station. It will remain until mid-September when the spacecraft will return to Earth with results of earlier experiments, splashing down in the Pacific Ocean off the coast of Baja California.

INDUSTRIAL STRENGTH

Turn basin prepped for Space Launch System core stage arrival

BY LINDA HERRIDGE

When the core stage for NASA's massive Space Launch System (SLS) rocket departs the Michoud Assembly Facility in New Orleans, it will be shipped by barge to the Launch Complex 39 turn basin wharf at NASA's Kennedy Space Center in Florida to be integrated with other hardware in preparation for its first launch, known as Exploration Mission-1. Modifications are underway to upgrade the wharf and prepare for the arrival of the core stage.

A crane is being used to lift up precast concrete poles and position them to be driven to a depth of about 70 feet into the bedrock below the water around the turn basin wharf. Photo credit: NASA/Kim Shiflett



Located just across the street from the iconic Vehicle Assembly Building (VAB), the dock area that was used for arrival and offloading of space shuttle external tanks is getting a makeover to accommodate the core stage when it arrives aboard NASA's modified barge Pegasus. The 212-foot-long core stage, which is more than 50 feet longer than the space shuttle tank, serves as the structural backbone of the rocket and includes the SLS propellant tanks and four RS-25 engines. When Pegasus arrives at Kennedy's turn basin, it will be carrying the core stage and all its ground support and transportation equipment -- cargo that is more than 600,000 pounds heavier than Pegasus transported for the space shuttle.

"The turn basin is undergoing significant structural modifications and electrical upgrades to be ready for the core stage and Pegasus barge," said Jimmy Rogers, a project manager with Kennedy's Ground Systems Development and Operations (GSDO) Program. "Analysis was performed on how Pegasus was going to be moored at the wharf to offset wind load scenarios. The barge's

length was increased to 310 feet to meet barge-to-dock interface requirements for the core stage."

The electrical system also is undergoing upgrades to meet new power requirements necessary to support Pegasus barge offloading operations. The new electrical system includes power receptacles for the SLS mobile transporter, which will carry the core stage to the VAB for processing and stacking.

Demolition and new construction began in December 2016 and is scheduled to be completed in August 2017. Southeast Cherokee Construction Inc., a woman-owned small business, is managing construction associated with the project for GSDO.

The work includes driving multiple precast concrete piles to a depth of about 70 feet around the wharf. A crawler crane lifts and

sets each pile in place. When they are at a specified location, a pile-driving rig "hammers" the piles through soil and bedrock below the water. Concrete also is being added to strengthen the wharf.

"Ultimately, the wharf soon will be ready to receive the core stage, as well as other flight hardware components scheduled for delivery at Kennedy," Rogers said.

NASA is preparing for the first integrated mission of the Orion spacecraft with the SLS rocket in 2019. During the uncrewed flight test, Orion will travel tens of thousands of miles beyond the Moon and return home with a splashdown in the Pacific Ocean.

Modifications are underway at the Launch Complex 39 turn basin wharf at NASA's Kennedy Space Center to prepare for the arrival of the agency's massive Space Launch System (SLS) core stage aboard the Pegasus barge. Precast concrete piles are being driven to a depth of about 70 feet into the bedrock below the water around the turn basin. The upgrades are necessary to accommodate the increased weight of the core stage along with ground support and transportation equipment aboard the modified barge Pegasus. Photo credit: NASA/Kim Shiflett



Construction workers with Southeast Cherokee Construction Inc. work to shore up the turn basin area. Photo credit: NASA/Kim Shiflett



Clouds stream past the mobile launcher, surrounded by cranes and rigging, in this long-exposure view at Kennedy Space Center.
Photo credit: NASA/Cory Huston

M A K I N G CONNECTIONS

Core stage forward skirt umbilical installed on mobile launcher

BY LINDA HERRIDGE

The Core Stage Forward Skirt Umbilical (CSFSU) recently was installed on the tower of the mobile launcher at NASA's Kennedy Space Center in Florida, to prepare for the first launch of the agency's Space Launch System (SLS) rocket with the Orion spacecraft atop.

The mobile launcher tower will be equipped with a number of lines, called umbilicals, which will connect to the SLS and Orion spacecraft and provide commodities during processing and preparation for launch of Exploration Mission-1.

Cranes and rigging were used to lift the CSFSU and install it at about the 220-foot level on the tower. The CSFSU will swing into position to provide connections to the core stage forward skirt of the SLS rocket, and then swing away before launch. Its main purpose is to provide conditioned air and gaseous nitrogen to the SLS core stage forward skirt cavity.

The Ground Systems Development and Operations Program is overseeing installation of the umbilicals on the tower.



Technicians install the Core Stage Forward Skirt Umbilical on the mobile launcher. Photo credit: NASA/Kim Shiflett



A crane lifts the Core Stage Forward Skirt Umbilical for installation onto the mobile launcher. Photo credit: NASA/Kim Shiflett



The first operational Saturn V rocket rolled out of the Vehicle Assembly Building on Aug. 26, 1967. Photo credit: NASA



An illustration of NASA's Space Launch System rolling out of the Vehicle Assembly Building atop the mobile launcher. Image credit: NASA

VAB's FIRST ROLLOUT

Launch vehicles prepared for destinations beyond low-Earth orbit

On Aug. 26, 1967, 50 years ago, the first operational Saturn V rolled out of the Vehicle Assembly Building at NASA's Kennedy Space Center in Florida, seen in the photograph on the left. After several months of checkouts, the massive launch vehicle lifted off on Nov. 9, 1967, for the uncrewed Apollo 4 mission. The flight helped pave the way for the first landing on the Moon less than two years later.

NASA now is preparing for the next large rocket -- the Space Launch System, or SLS. Inside the Vehicle Assembly Building, installation of 10 levels of work platforms has been completed to support the SLS and the Orion crew spacecraft. The platforms will

surround the launch vehicle, allowing access during processing. In the illustration, the new rocket rolls out of the VAB for Launch Complex 39B atop the mobile launcher.

The SLS launch vehicle is a new heavy-lift rocket, more powerful than any previously built. It is designed to send astronauts aboard Orion beyond low-Earth orbit to destinations such as Mars. The first integrated mission for SLS and Orion is scheduled for 2019. During the Exploration Mission-1, Orion will travel tens of thousands of miles beyond the Moon and splash down in the Pacific Ocean. Photo credits: NASA

AUTHORITY TO OPERATE



The Kennedy Ground Control System team poses at Kennedy Space Center's Operations Support Building II after signing a banner to celebrate receiving authorization to operate. Photo Credit: NASA/Cory Huston

Kennedy engineers to support liftoff of world's most powerful rocket

BY LINDA HERRIDGE

Liftoff of NASA's Space Launch System (SLS) rocket and Orion spacecraft from Launch Complex 39B at the agency's Kennedy Space Center in Florida will require a symphony of tightly coordinated commands for processing and launch. Kennedy engineers recently achieved authorization to operate the Kennedy Ground Control Subsystem, which is a network of controls, during hazardous operations at the Multi-Payload Processing Facility. The processing facility is used to prepare Orion for its test flight atop the SLS.

To gain authorization to operate, Kennedy updated access to the subsystem network and equipment, ensuring the network is secure from all malicious threats, whether internal or external. Kennedy now is prepared to support hazardous operations and ensure that the network meets agency standards for network and physical protection.

According to Reggie Martin, a NASA electrical engineer in the Engineering Development Lab at the center, an authorization is good for only one year.

"Each subsequent authorization is a review to ensure we continue to operate at the level first certified to operate," Martin

said. "It also includes a review of any new equipment or operations to ensure they are properly incorporated as we get closer to the launch of NASA's Space Launch System on Exploration Mission-1."

The subsystem of the Spaceport Command and Control System is the main integration network system between ground support equipment at various locations around Kennedy and the Launch Control Center. The network interfaces with ground support equipment, such as sensors, valves and heaters, with systems in the Vehicle Assembly Building, the mobile launcher, the Launch Abort System Facility, the processing facility and on Launch Pad 39B to facilitate monitoring and control of subsystem processes.

"We're responsible for ensuring all ground operations are transmitted to ground support equipment to ensure timely launch processing and vehicle launch from the launch pad," said Martin.

Martin led a team of NASA and contractor engineers in the integrated design, fabrication, installation, verification and validation of the mission's operational information and security requirements in support of hazardous operations.

The subsystem is monitored by NASA and contractor engineers from consoles located in the Launch Control Center's Firing Room 1.

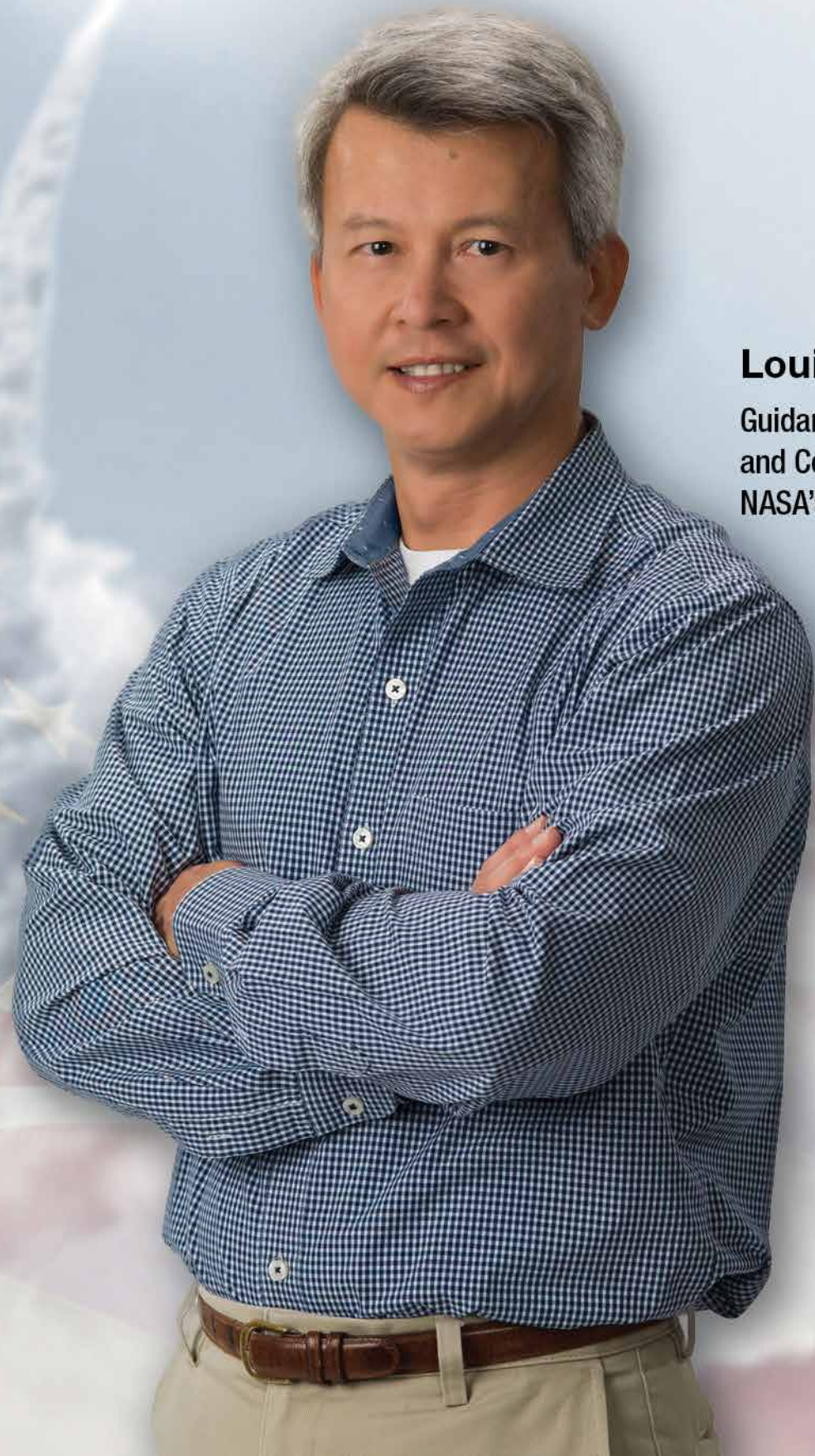
SCENE @ KENNEDY SPACE CENTER



A large turtle traverses across rocky terrain toward sea oats near an old railroad crossing sign at Kennedy Space Center in Florida. Photo credit: NASA/Bill White

I Will LAUNCH AMERICA

Restoring America's Human Launch Capability



Louis Nguyen
Guidance, Navigation
and Control Engineer
NASA's Commercial Crew Program

I Will Launch America: Louis Nguyen

BY STEVEN SICELOFF

Much of Louis Nguyen's space career has played out against a backdrop of bridging cultures. Working first with the space shuttle, then on the International Space Station and in NASA's Commercial Crew Program, Nguyen has teamed with contractors, federal workers, international partners and now aerospace industry partners to build and operate human space systems.

Today, Nguyen is part of the NASA Commercial Crew Program that is partnering with aerospace companies to produce new spacecraft and launchers capable of flying astronauts to the International Space Station on crew rotation missions. The partnerships combine private enterprise innovations in manufacturing and design with NASA's expertise in spaceflight.

As a NASA engineer in guidance, navigation and control, Nguyen evaluates the companies' systems that steer and tell a spacecraft where it is and where it's going. He works closely with both Boeing and SpaceX as the two companies build separate launch systems that NASA will certify for use.

"Each partner is different and offers different challenges," Nguyen said. "We've developed a rapport with the engineers so they understand we're here to share ideas and our assessments of the design. We're really here to support them and their goals because they are our goals too."

As part of the engineering teams that will certify the launch escape systems in Boeing's CST-100 Starliners and SpaceX's Crew Dragons, Nguyen and his group must predict how some of the most complex elements of new spacecraft will operate in the toughest conditions of flight, including an aborted launch.

Each company built high-speed engines into their spacecraft that can fire quickly to lift the ship and its crew away from a failing booster, allowing the spacecraft to parachute down to Earth and out of danger. Unlike the designs for Mercury and Apollo spacecraft in the 1960s that placed the escape thrusters on top of the capsules to pull them away from the rocket, Boeing and SpaceX integrated their abort systems into the main body of the spacecraft or just below the crew module.

"It's exciting in the sense that they're not the same systems used for Apollo and Mercury," Nguyen said. "These two systems, because they are different, you get to see the pros and cons and compare. To me, it's all about engineering solutions to the challenges."

The likelihood of an emergency during a launch is remote and launch abort systems have not been used before during ascent. But the systems have to be certified to work as planned in case they are needed. The launch escape system components in each spacecraft are to be tested extensively during development, including flight tests simulating emergencies while the rocket is still on the launch pad.

But even before the flight tests take place, engineers, including Nguyen, will conduct scores of simulations using complex computer models that take into account all the variables and how they interact during the course of liftoff, flight through the atmosphere and into orbit.

SpaceX conducted its pad abort test at Kennedy in 2015, a demonstration that Nguyen said verified the results of the computer simulations. Boeing's pad abort test is scheduled for next year.

Developing and perfecting simulations and computer models is not new to Nguyen. Nguyen, who was born in Vietnam, arrived at Johnson Space Center in Houston in 1987 after graduating from the University of Illinois. He worked on the simulations astronauts used to formulate and then practice the methods to deploy payloads such as the Hubble Space Telescope from the cargo bay of the space shuttles. It was delicate work because unsafe interactions between flexible structures and the flight control system can build up quickly in the weightless realm of orbit.

Nguyen next worked on the space station project, beginning at the time when the American-Russian partnership was getting to the point where technical data and devices were being verified for operations on the station. The engineers learned quickly how to capitalize on each other's strengths, including evaluating the Russian flight control system in NASA's space station simulations.

"The team together could assess and verify every operation that we did on orbit and that's similar to what we do with the commercial partners now," Nguyen said.

CLEANING UP

Kennedy scientists developing technology to remove Martian dust

BY BOB GRANATH

NASA's Journey to Mars requires cutting-edge technologies to solve the problems explorers will face on the Red Planet. Scientists at the agency's Kennedy Space Center in Florida are developing some of the needed solutions.

Dr. Carlos Calle, lead scientist in the center's Electrostatics and Surface Physics Laboratory, and Jay Phillips, a research physicist working there, are developing an electrostatic precipitator to help solve the dust problem.

"Commodities such as oxygen, water and methane can be obtained from the carbon dioxide-rich Martian atmosphere," Calle said. "Astronauts will need these essentials as they practice in-situ resource utilization."

In-situ resource utilization, or ISRU, is harvesting and relying on available raw materials as astronauts visit deep space destinations. Like early European settlers coming to America, planetary pioneers will not be able to take everything they need, so many supplies will need to be gathered and made on-site.

An electrostatic precipitator works by capturing the fine dust from a gas stream while it travels between a pair of high-voltage electrodes. The electrodes induce an electrostatic charge on the dust particles that causes them to migrate to an oppositely charged electrode.

Electrostatic precipitators are efficient collectors of small particles and are widely used in industrial applications, such as removing particles from plumes at power plants.

Phillips explained that he and Calle are conducting experiments to adapt an existing technology for use on Mars.

"Electrostatic precipitators will remove dust from the atmospheric gas intakes on the Martian ISRU processing plants," Phillips said. "Dust can damage equipment and must be separated from the atmosphere prior to producing the consumables astronauts will require for life support and fuel on Mars."

Phillips noted that a Martian version of the electrostatic precipitator technology would need to be highly modified for use there.

"The plan is to send an electrostatic precipitator and other equipment to a landing site to prepare for the arrival of the crew," he said.

In their Swamp Works laboratory, Calle and Phillips are using dust that closely approximates the makeup of that on Mars. They upgraded their electrostatic precipitator to simulate Martian atmosphere by designing and constructing a dust aerosolization prechamber. The atmospheric pressure on the Martian surface averages about 0.6 percent of Earth's mean sea level pressure and is composed mostly of carbon dioxide.

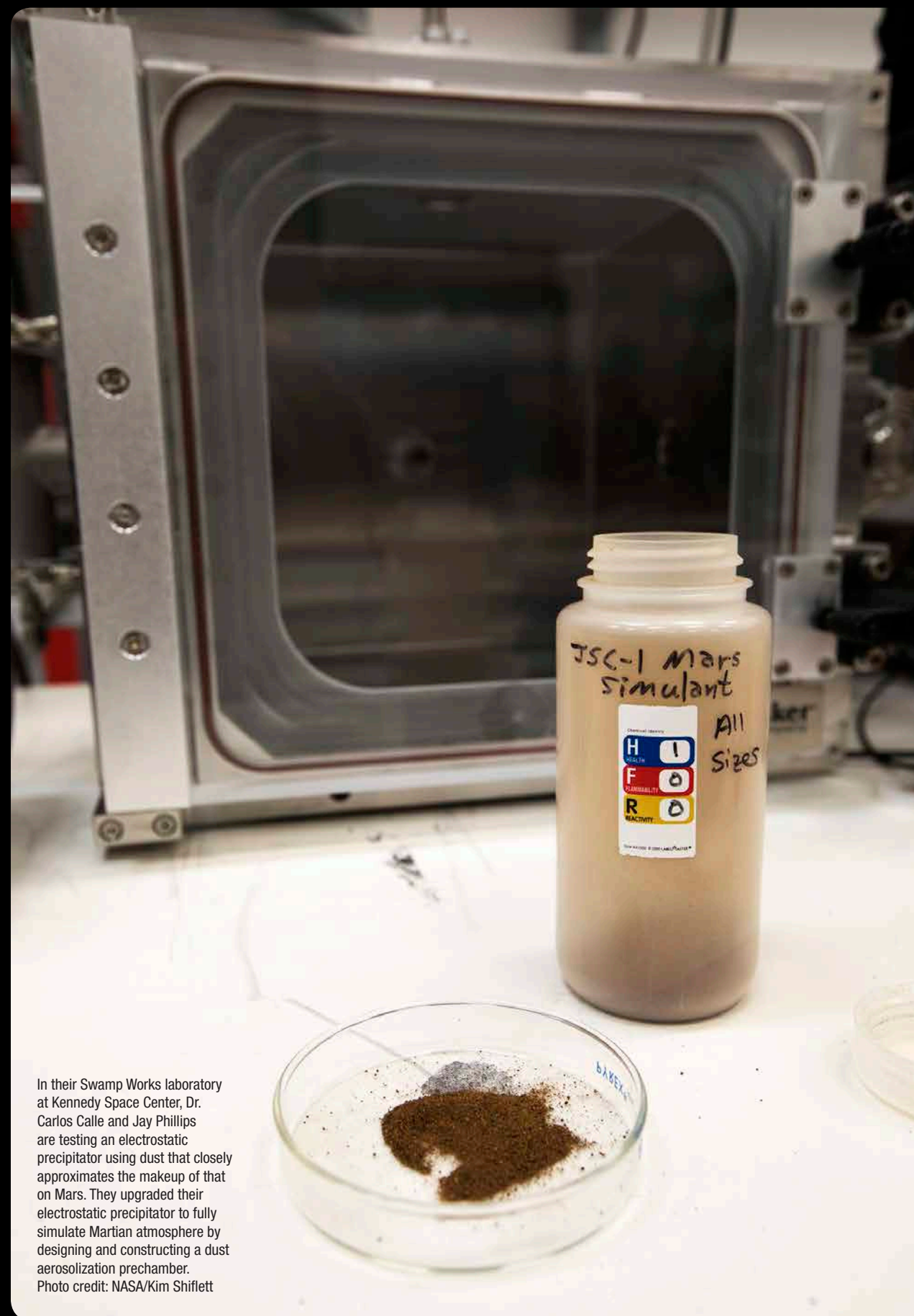
Aerosolization is a process that converts a substance into the form of particles small and light enough to be suspended into the air in a manner similar to an aerosol.

"The challenge on Mars is the much lower atmospheric pressure there compared to the atmospheric pressure on Earth," Calle said.

The end result of the current project is to develop a new generation electrostatic precipitator system capable of removing dust in the environment of the Red Planet, enabling future space pioneers to live off the land.



Dr. Carlos Calle, lead scientist in Kennedy Space Center's Electrostatics and Surface Physics Laboratory, left, and Jay Phillips, a research physicist, are modifying an electrostatic precipitator. On Mars, the device would allow astronauts to extract useful elements such as oxygen, water and methane. Photo credit: NASA/Kim Shiflett



In their Swamp Works laboratory at Kennedy Space Center, Dr. Carlos Calle and Jay Phillips are testing an electrostatic precipitator using dust that closely approximates the makeup of that on Mars. They upgraded their electrostatic precipitator to fully simulate Martian atmosphere by designing and constructing a dust aerosolization prechamber. Photo credit: NASA/Kim Shiflett

INVESTING IN THE FUTURE



Teachers, administrators hone integrated approach to STEM

BY ANNA HEINEY

The connections between problem-solving and success are visible around every corner at NASA's Kennedy Space Center in Florida. So it was a natural venue for educators and administrators who gathered at the Center for Space Education at Kennedy to brainstorm new ways to teach science, technology, engineering and math, the STEM disciplines, and how to weave the subjects together to develop problem-solving skills in today's students.

During the GE Foundation High School STEM Integration Conference, teams of teachers, principals and district-level administrators from across the country took part in discussions, presentations and hands-on demonstrations at the spaceport. The GE Foundation partnered with the National Science Teachers Association (NSTA) for the weeklong event, which also highlighted ways to use STEM and critical-thinking lessons to engage students from diverse backgrounds and varied experiences.

"The intent is to provide the educators hands-on experiences that they could replicate in their classrooms. Reach one teacher and they

in turn can reach hundreds of students," said Steve Chance, a NASA education programs specialist at Kennedy.

"NASA represents to us the pinnacle of human endeavor, of our greatest problem-solving and critical thinking," said John Putnam, assistant executive director of professional learning with the NSTA. "So what better place than to come to NASA to engage the teachers and the administrators in these kinds of activities?"

To integrate STEM education throughout a curriculum takes additional planning, but creates a holistic approach that bears a closer resemblance to the real world, where issues are complex and not easily solved using, for example, only math or chemistry.

"When NASA, or other organizations, are looking at large-scale, systemic problems, or addressing a localized STEM problem in the community, they don't look at it and say, 'Let's go learn some chemistry first, and then we'll learn some math,'" Putnam said. "It's just a problem, and they ask, 'What do we need to know to be able to solve that problem?'"



Teachers participate in the Rocketry Engineering Design Challenge during the 2017 GE Foundation High School STEM Integration Conference at the Center for Space Education at NASA's Kennedy Space Center. Photo credit: NASA/Chris Chamberland



Teachers prepare to demonstrate the projects they built for the Rocketry Engineering Design Challenge. Photo credit: NASA/Chris Chamberland

Emphasis on STEM education is not new. What's new is the realization that while teaching the material is important, it's also imperative that students learn the broader skills that will help prepare them for a future with opportunities and needs we can't yet foresee.

"We want to ensure all students and children become the best they can be and that any career is possible," said Jan Haven, director of the Department of GE and Strategic Engagement at Milwaukee Public Schools.

"STEM is an equity maker," she added. "If I can integrate STEM in meaningful ways in the classroom, I'm giving everybody a chance. It's just best practice."

Deon Edwards, a ninth-grade engineering teacher from Akin High School in Cincinnati, Ohio, looks forward to bringing some new ideas to his classroom and expanding some of the projects his students have already experienced.

For example, Edwards' students do a balloon launch every year - including a LEGO "astronaut" this past year. The conference inspired him to add a mission control center next time.

"They can do all the things mission controllers do, such as checking the weather," Edwards said. "We can have everybody in their roles. We can simulate that pretty well."

After the conference concluded July 14, the teams headed home, equipped with new ideas and resources for their students -- and inspired by the opportunities ahead.

"I feel like one of our students could be the first astronaut to go to Mars -- or one of those working on sending somebody there, working at NASA," Edwards said.



BY DOUGLAS M. SCHEIDT AND JANE A. PROVANCHA

Since August of 1963, Kennedy Space Center has coexisted with Merritt Island's National Wildlife Refuge. Just south of Launch Pad 39A, manatees graze protected in a sanctuary in the northern end of the Banana River. Between May and September, thousands of endangered sea turtles come ashore on this barrier island in the dark of night to lay their eggs. Merritt Island's strategic location along the Atlantic Flyway provides a resting and feeding place for thousands of ducks, wading birds, shorebirds and songbirds. Diverse habitats that include brackish marshes, salt water estuaries, hardwood hammocks and upland scrub provide homes to an amazing diversity of more than 500 species of fish and wildlife, including many that are protected under the Endangered Species Act. Today, these 220 square miles are managed by the Department of the Interior as a national wildlife refuge and national seashore with the exception of about 10 square miles dedicated to the launch, landing and processing facilities that support the space program. In this Q&A installment about responsibilities of Kennedy's Ecological Program, we provide information on manatees and their significance to Kennedy's ecosystem. Included are facts about basic manatees' biology, federal protection, and what we can do to ensure their continued survival. Remember, it is all of our responsibility to leave this planet in better shape for future generations than we found it.

Q: What role does Kennedy Space Center play in the protection of manatees?

Surveys conducted by the U.S. Fish and Wildlife Service in 1977 concluded that large numbers of manatees occurred in the Indian River Lagoon on Kennedy. Because NASA also was using the same bodies of water to support space operations, it became clear that requirements of the National Environmental Policy Act and the Endangered Species Act would best be met by monitoring this endangered species and its habitat. Aerial surveys of the distribution and abundance of manatees at Kennedy were funded by NASA intermittently from 1977-1983, and almost continuously since 1984 when the Kennedy Ecological Program began.

Q: Are manatees native to Florida?

The West Indian manatee is native to the waters of the Caribbean and southeastern U.S. In the U.S., they are mainly found in Florida, but during warmer months manatees can be found from South Carolina to Texas. A few wayward manatees have traveled in summer to Chesapeake Bay (1995) and New York's Hudson River

(2006). Manatees inhabit fresh water, estuarine, and nearshore ocean waters.

Q: How large are manatees and how many young do they have?

Adult manatees range in size from 9 to 11 feet and can weigh 1,000 to 1,500 pounds. Typically, adult females are larger than males. Female manatees reach maturity around 5 years and males between 7-9 years. Females are capable of reproducing year round, but most mating activity occurs in spring. Gestation is 12 months, and the mother cares for the calves for an additional 12 to 18 months. Females typically give birth once every three years.

Q: What do they eat?

Manatees are herbivores that feed mainly on seagrasses in brackish and salt water, and on vegetation such as eelgrass in fresh water. Although they can graze heavily in a given area, they typically do not destroy the vegetation and it regrows for future feeding.

Q: How do manatees get fresh water?

Manatees living in nearshore ocean and estuarine areas cannot obtain enough fresh water from their food to survive. They must periodically visit areas of fresh water such as rivers, creeks or canals to drink. Caution: Many people are tempted to leave hoses with fresh water running in areas to attract manatees. This is harmful to manatees as it disrupts their natural movements and may put them at risk. Besides, it's illegal!

Q: What is special about a manatee's teeth?

Most of the teeth are flat molars arranged in long rows to help grind their food. The teeth wear down over time from the grinding action and abrasive sand. Worn teeth are constantly replaced throughout the manatee's life, with new teeth in the back of the jaw pushing older teeth to the front until they eventually fall out.



Manatees observed during an aerial survey of Kennedy Space Center waters. Photo credit: Kennedy Space Center Ecological Program.

Q: How does water temperature impact manatees?

Even though the manatee is a warm-blooded marine mammal, it has a very thin fat layer (not blubber). They are greatly impacted by temperature and can become stressed when water temperatures reach below 68 degrees F. Prolonged exposure to colder temperatures can cause short-term or long-term health issues, and even death. In the winter months, manatees seek warm-water refugia, such as freshwater springs

or man-made warm-water sources like power-plant outflows, or they migrate further south to warmer areas.

Q: What is the manatee sanctuary in the Banana River?

By 1990, Kennedy data showed how important the waters surrounding the space center were to manatees, especially during the warm seasons. This information led the U.S. Marine Mammal Commission and the U.S. Fish and Wildlife Service to officially designate the Kennedy portion of the Banana River as a manatee sanctuary. This prohibits all non-Kennedy motorized boats from entering into these waters, allowing manatees to utilize the area with minimal disturbance.



These synchronized swimmers are actually an adult manatee and its baby surfacing in the turn basin in Launch Complex 39 at Kennedy Space Center. The turn basin is a refuge for manatees and other marine life during the hot summer months on the Space Coast. Photo credit: NASA/Matthew J. Porter

Q: How many manatees are at Kennedy Space Center?

The answer to this often-asked question is "variable" as manatees travel quite a bit in and out of the space center during the year. The overall trend in the number of manatees in Kennedy waters has steadily increased over time. In the spring of 2012, the highest number counted was over 1,000 manatees, just within Kennedy Space Center! The numbers level off during each summer for an average of 200 to 300. Since the late 1980s, the Kennedy waters have been utilized by 20 to 50 percent of the east Florida coast estimated population.

Q: What do I do if I see an injured, distressed or dead manatee?

Maintain a safe distance from the animal, observe its behavior, document the location, and call the Wildlife Alert Hotline (888-404-3922) or text tip@myfwc.com.

SUCCESS REMEMBERED

Launching Cassini leaves legacy of lasting pride

BY STEVEN SICELOFF

As NASA's Cassini spacecraft spends its last few weeks in orbit around Saturn before making a controlled impact with the planet in what NASA dubbed Cassini's "Grand Finale," some of those who helped launch the mission 20 years ago are thrilled with the success of the massive probe they helped dispatch to one of the solar system's most intriguing worlds.





A seven-year journey to the ringed planet Saturn began with the liftoff of a Titan IVB/Centaur carrying the Cassini orbiter and its attached Huygens probe. This spectacular streak shot was taken from Hangar AF at Cape Canaveral Air Force Station (CCAFS), with a solid rocket booster retrieval ship in the foreground. Launch occurred at 4:43 a.m. EDT on Oct. 15, 1997, from Launch Complex 40 at CCAFS. After a 2.2-billion mile journey that included two swingbys of Venus and one of Earth to gain additional velocity, the spacecraft arrived at Saturn on June 30, 2004. Photo credit: NASA

“There’s just a real sense of fulfillment associated with being part of a launch team, particularly something as big as Cassini and as complicated as Cassini is and the whole makeup of the whole Cassini team,” said Ray Lugo, launch director for Cassini. “It was a big community of folks and everybody had to do their part to make sure that mission got off right.”

It took seven years for Cassini to make the trip from Earth’s surface to Saturn’s orbit. The two-story-tall spacecraft reached Saturn on June 30, 2004, to begin unprecedented surveys of the planet and its brilliant rings, along with Saturn’s eclectic system of moons. As the mission comes to a close, NASA opted to plunge the spacecraft into Saturn to prevent it from accidentally contaminating one of the moons if it were left to drift around in space.

Cassini also carried a second spacecraft along with it, a probe called Huygens that was released to study the moon Titan up close. Huygens parachuted to the surface of the moon, relaying data on conditions there until its batteries ran out.

For Lugo, that success was hoped for, but not taken for granted.

“For some of those scientists, they spent their lifetime to make something like that happen,” Lugo said. “Somebody had to have the idea for this mission, somebody had to write up a proposal for the mission, probably multiple proposals, finally get selected, fly it and then do the science. Thinking of it in that way kind of sets an expectation. You know on launch day that all this work we did and they did could be lost, and you think about that.”

Cassini, which was built and operated from the Jet Propulsion Laboratory in Pasadena, California, lifted off from Cape Canaveral, Florida, in 1997 atop a Titan IVB rocket. The launch capped months of processing on the spacecraft and booster to make sure everything would work correctly on launch day and Cassini would be set on its correct path.

The Cassini mission would be only Lugo’s second at the helm of the launch team. Because his first launch was not successful, he said he felt added weight heading into the Cassini campaign.

“Here I am a freshly minted launch director coming into one of the flagship missions for NASA and I’m batting zero-for-one,” Lugo said. “so it wasn’t like there wasn’t any pressure. It was a very important mission, it was complicated.”

The Titan IVB rocket was NASA’s largest expendable booster at the time.

“We’d never launched anything as large as Cassini before on an expendable vehicle, and there wasn’t a rocket that big before unless you went back to Apollo,” said George Diller, NASA’s launch commentator.

The spacecraft lifted off on its second try to cap a smooth, if lengthy, countdown procedure that saw the teams on their consoles for 12 straight hours through liftoff. Located at different facilities around Cape Canaveral and Kennedy Space Center for launch, along with mission operations centers in California and Europe, the countdown encompassed a wide array of people and organizations.




The Cassini spacecraft, with the Huygens probe, sits atop a Titan IVB expendable launch vehicle at Launch Complex 40 at Cape Canaveral Air Force Station on Sept. 21, 1997, where it awaits placement of its payload fairing to protect Cassini during launch. Instruments mounted on the Huygens probe were developed by the European Space Agency. Photo credit: NASA

Despite the size of the rocket, Cassini would still take seven years to reach Saturn. It would fly a precise path through the inner solar system, building up speed by passing near Venus and Earth so it could slingshot out beyond Mars and Jupiter to rendezvous with Saturn. Getting on that path correctly at the start was the focus of the launch team.

“After the second burn of the Centaur upper stage, which got Cassini out of Earth orbit and onto an interplanetary trajectory, that’s when everybody felt like ‘OK, we’ve got it in hand,’” Diller said.

The payoff has been a wealth of photos and data of one of the solar system’s most captivating locations.

“You see Cassini approach Saturn and get these good pictures and you think, ‘Wow, I was a part of something that really redefined the understanding of a planet like Saturn and the rings,’” Lugo said. “I wasn’t responsible for the science, but I can take some comfort in the fact that what I was able to do helped make that happen.”



A Titan/Centaur-7 rocket lifted off Aug. 20, 1977, from Launch Complex 41 at Cape Canaveral Air Force Station at 10:29 a.m. EDT sending the 1,800-pound Voyager 2 spacecraft on an odyssey through the outer planets, including Jupiter, Saturn, Uranus and Neptune. Voyager 2 explored 48 of their moons and the unique system of rings and magnetic fields those planets possess. Voyager 2's closest approach to Jupiter occurred on July 9, 1979. Travelling at a rate of more than 292 million miles per year, the Voyager 2 space probe is currently on its way out of our solar system and nearing interstellar space. Photo credit: NASA

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