

National Aeronautics and
Space Administration



ORION

JULY 2017



**“WE WILL PUT AMERICAN
BOOTS ON THE FACE OF MARS”**

ORION'S MONTHLY HIGHLIGHTS



VP PENCE TALKS FUTURE OF DEEP SPACE EXPLORATION



NASA ASTRONAUTS MAKE A BIG SPLASH IN THE GULF OF MEXICO



UK STUDENTS EXPERIENCE SPACE ADVENTURE STATESIDE



SOUND BLAST: TESTING SPACECRAFT INTEGRITY



DESIGNED WITH HUMANS IN MIND



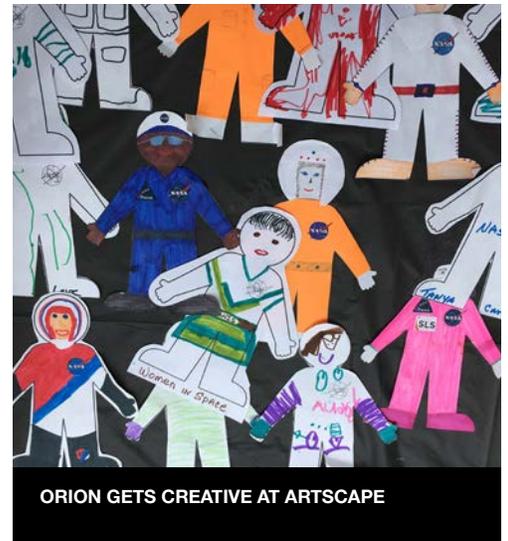
100 YEARS AND COUNTING



SUPPLIER SPOTLIGHT



FROM ONE FRONTIER TO ANOTHER



ORION GETS CREATIVE AT ARTSCAPE



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Pictured from left to right are U.S. Senator Marco Rubio (R-FL); Acting NASA Administrator Robert Lightfoot; Lockheed Martin Chairman, President and CEO Marillyn Hewson; Vice President Mike Pence, NASA Kennedy Space Center Director Robert Cabana; and NASA Kennedy Space Center Deputy Director Janet Petro.

VP PENCE TALKS FUTURE OF DEEP SPACE EXPLORATION

Vice President Mike Pence thanked employees at NASA's Kennedy Space Center in Florida for their commitment to America's continued leadership in the space frontier during a visit to America's multi-user spaceport on July 6.

Acting NASA Administrator Robert Lightfoot thanked Vice President Pence and the administration for their strong support, and pointed out the evidence of government and industry cooperation on display at Kennedy.

Vice President Pence also got a first-hand look at the public-private partnerships at Kennedy during a tour that showcased

both NASA and commercial work that will soon lead to U.S.-based astronaut launches and eventual missions into deep space.

The Vice President visited the center's Neil Armstrong Operations and Checkout Building, where the NASA and Lockheed Martin industry teams are preparing the Orion spacecraft for its first integrated flight with SLS in 2019. Orion has elements made in America by workers at more than 1,500 companies in 48 states, and some of that work, including components of Orion's protective heat shield, was on display during the tour.

See more: bit.ly/VPpenceKSC



NASA ASTRONAUTS MAKE A BIG SPLASH IN THE GULF OF MEXICO

When astronauts return to Earth from destinations beyond the moon in NASA's Orion spacecraft and splashdown in the Pacific Ocean, they'll still need to safely get out of the spacecraft and back on dry land. Using the waters off the coast of Galveston, Texas, a NASA and Department of Defense team tested Orion exit procedures in a variety of scenarios the week of July 10.

During the crew egress testing, a joint team from the Orion and Ground Systems Development and Operations programs, along with assistance from the U.S. Coast Guard, Navy and Air Force, evaluated how the crew will get out of the capsule with assistance and by themselves.

NASA is developing multiple methods to get the crew out of the spacecraft on the day they return home. These methods give recovery personnel and mission controllers flexibility to account



for the crew's health, weather and the condition of the recovery personnel and equipment in the area in real-time.

Orion is designed to sustain a crew that has splashed down in the ocean for up to 24 hours. When the capsule and its crew return from deep space missions, during one recovery method, small boats of Navy personnel will arrive soon after landing. They will assist the crew as they exit through the side hatch of the capsule and onto rafts, and take them and the capsule back to an awaiting Naval ship.

NASA also is evaluating how well crew members can get out of the spacecraft within three minutes and into a raft by themselves, without the assistance of recovery personnel. On human missions, Orion will be equipped with such a raft and a few additional emergency supplies such as water, tools and signaling mirrors, should the crew ever be in a situation where a team of

recovery personnel is not immediately available to assist them.

Astronauts and engineering test subjects wore Orion Crew Survival System spacesuits, modified versions of NASA's orange Advanced Crew Escape suits in development for use during Orion launch and entry, making the testing as true to mission scenarios as possible.

Orion will send astronauts farther into space than humans have ever traveled before. While engineers are currently building the spacecraft for Orion's first uncrewed flight atop the agency's powerful Space Launch System rocket, NASA is working hard to develop and build the spacecraft elements, tools and techniques required to ensure a safe, successful journey when astronauts fly on the spacecraft beginning with Exploration Mission-2.

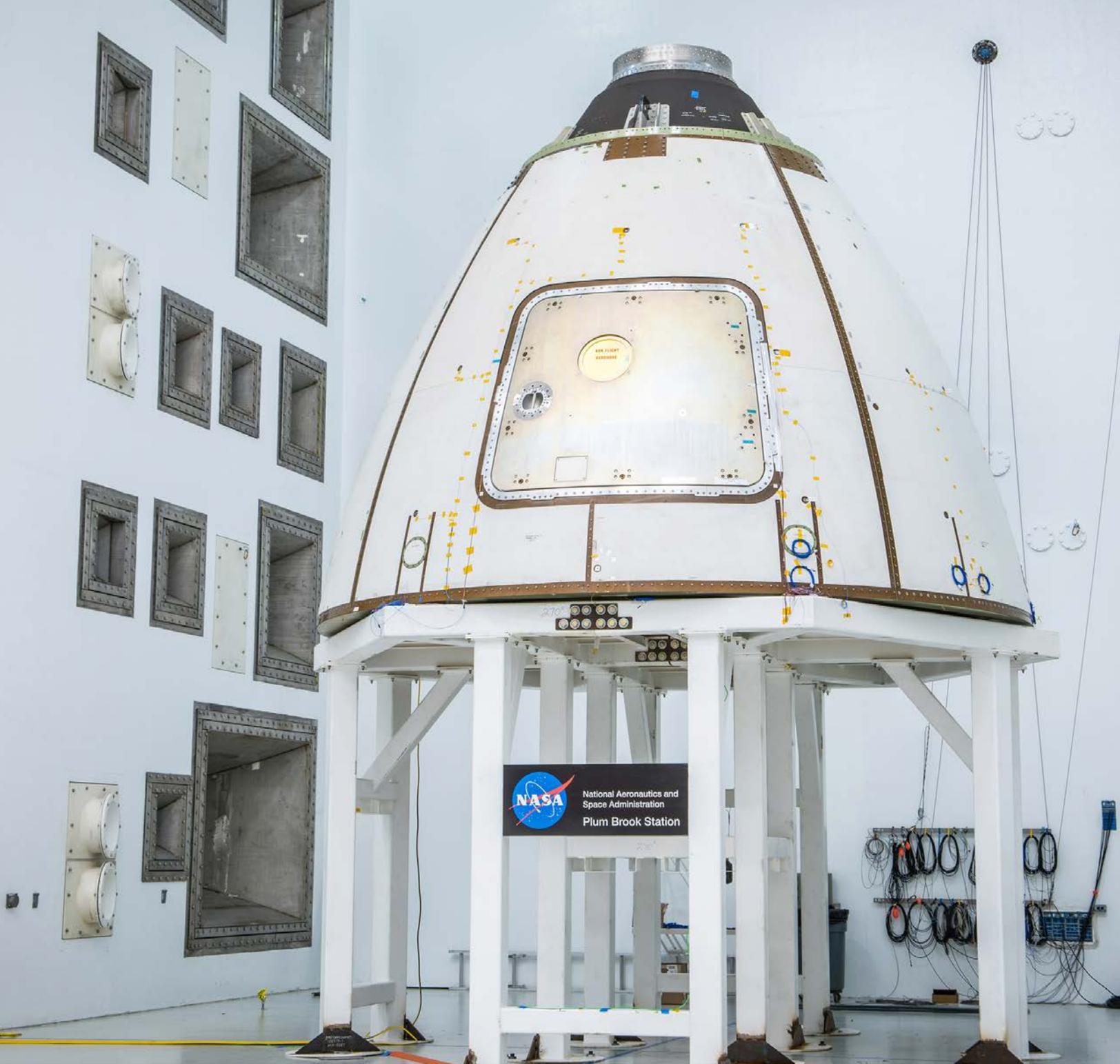
Learn more in this ABC13 story: bit.ly/OrionEgressTest



UK STUDENTS EXPERIENCE SPACE ADVENTURE STATESIDE

Every year, as a part of Space Education Adventures, a group of 20-30 British high school students come to the United States to visit and learn about NASA's space program. The students and their teachers had behind-the-scenes tours of both Johnson Space Center and Kennedy Space Center. On this trip they learned about the past, present and future of these historic places, where great achievements in space exploration continue to inspire the next generation. Students were able to meet engineers and scientists working in the space industry, including Orion engineer Dustin Neill and intern Sam Zorek. Through these interactive and engaging talks, the students gained valuable advice for envisioning their own potential for exciting STEM careers. It is engaging interactions such as these that enable the fostering of stronger international collaborations.





SOUND BLAST: TESTING SPACECRAFT INTEGRITY

Engineers are currently testing the Orion spacecraft's ogive at the Reverberant Acoustic Test Facility at NASA Glenn Research Center's Plum Brook Station in Sandusky, Ohio. The ogive protects the crew module from the harsh acoustic and vibration environments experienced during launch and ascent and is part of the spacecraft's launch abort system, which is designed to protect astronauts if a problem arises during launch or ascent by pulling the crew module away from a failing rocket. Plum Brook Station

facilities are uniquely equipped to replicate the acoustics and vibrations Orion will experience during its missions in space. The ogive is installed in the Reverberant Acoustic Chamber, which is a massive room surrounded with large-scale speakers where it will be blasted with 161 decibels of sound to simulate launch conditions.

Meet musician and Orion acoustic engineer Aron Hozman:
bit.ly/MeetAronHozman

WHAT IT TAKES TO COME HOME SAFELY

LOW EARTH RETURN

vs

LUNAR RETURN

3 HOURS

24X
LONGER

3 DAYS

3,000°F

73%
HOTTER

5,200°F

17,000 MPH

7,700
MPH FASTER

24,700 MPH

250 MILES

1,000X
FARTHER

240,000 MILES

ONLY ORION CAN DO DEEP SPACE

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DESIGNED WITH HUMANS IN MIND

It's the early 2020s. A crew of astronauts are secured in their seats inside Orion, eagerly awaiting the launch countdown to begin. It's the spacecraft's first crewed mission – heading beyond the moon. Behind this snapshot in time is years of ingenuity and preparation. All in the name of figuring out how to ultimately do something we've never done before: send humans to Mars.

In space, you have to plan for the most extreme scenarios, because they can and will happen. That's why NASA and Lockheed Martin spend thousands of hours designing, testing, and tweaking Orion systems until they're just right.

Without question, the two parts of spaceflight toughest on the human body are launch and landing. Astronauts will be subjected to extreme forces as they launch with Orion on the top of the Space Launch System – which will be the world's most powerful rocket, producing 8.8 million pounds of thrust – not to mention intense vibrations for the spacecraft and its crew.

In space, your backups must have backups. Even if you're prepared for any situation, anything can happen on a mission. If an unexpected issue occurs and endangers the astronauts during

launch or on the pad, the Launch Abort System will ignite within the blink of an eye to pull the capsule – and its crew – safely away from the rocket. This is the crew's last line of defense, it is the quickest and most reliable way to get astronauts to safety.

The farther away you go in space, the more challenging the return to Earth. Coming back from the moon's vicinity will take at least three days compared to just three hours returning from low-Earth orbit. Now, consider the six- to nine-month journey to Mars.

When distance increases, return speed skyrockets and the temperature upon re-entering Earth's atmosphere dramatically increases. That's why Orion's heat shield has been designed and tested to the extremes – subjecting it to the 5,200 degrees it will see as it rips through the atmosphere at 24,700 mph.

As humans, we're naturally driven to explore the unknown, and Orion will help us do just that. As we continue to explore and push the exploration boundaries of our universe, NASA and Lockheed Martin teams will ensure the safety of those brave enough to go where no one has gone before.

Video: bit.ly/HumansInMind



100 YEARS AND COUNTING



Founded in 1917, NASA's Langley Research Center in Hampton, Virginia, has and continues to innovate air and spaceflight. From the building of the Bell X-1, which was famously piloted by Chuck Yeager who broke the sound barrier, to helping land men on the moon, Langley has had a large role in pushing the boundaries of air travel. Langley managed Project Mercury and played a major role in both the Gemini and Apollo programs, training Neil Armstrong and many others on lunar landings. One hundred years later Langley continues to inspire with their support of Orion and the Space Launch System, the next generation of spaceflight.

Langley has also contributed to the recovery, drop, heat shield, wind tunnel and structural impact testing for the Orion capsule. In 2016 they did a series of nine drop tests to simulate the capsule landing in the Pacific Ocean after a deep-space flight. The tests of a representative Orion crew capsule with crash test dummies inside help engineers understand what the spacecraft and astronauts may experience when landing after a deep space mission.

Learn more: bit.ly/Langley100

SUPPLIER SPOTLIGHT

FRONTIER ELECTRONICS



Frontier Electronic Systems Corp. is a Native American-owned small business located in Stillwater, Oklahoma, since 1981. The assemblies that Frontier contributes to NASA's Orion program are integral to the spacecraft's power management and distribution, as well as its environmental control and life support systems. Frontier provided these assemblies for the successful Exploration Flight Test-1 in 2014 and will continue to contribute them to Exploration Mission-1 and Exploration Mission-2.

Frontier has been supporting NASA for over 20 years, and has earned two NASA special recognition awards for its contribution to the agency's success. In addition to the Orion program, Frontier has worked on parts for the International Space Station, the Space Launch System, as well as the Aura and Aqua satellites. The Frontier team said they "are energized by the vast scope of the Orion program, and are thrilled to be part of bringing this challenging technical endeavor into a successful reality."



Chuck Gray (blue) vice president/chief operating officer of Frontier Electronic Systems Corp. shows Orion and SLS avionic components to Bill Deuerling (UTC Aerospace Systems), Paul Anderson (Lockheed Martin), Brian Smith (Lockheed Martin) and Annette Hasbrook (NASA) during a recent supplier event in Stillwater, Oklahoma, July 18.



FROM ONE FRONTIER TO ANOTHER

Steve Layne, Ground Based Strategic Deterrent Deputy Program Manager for Lockheed Martin, presented Wyoming Governor Matt Mead with a state flag flown in space at the Governor's Cheyenne Frontier Days opening reception held July 20. Cheyenne Frontier Days dates back to 1897 and is an annual celebration of Cheyenne, Wyoming's western roots, featuring the world's largest outdoor rodeo. Flags from all 50 states were flown aboard the Orion spacecraft which traveled 60,000 miles into space, reaching an altitude of 3,600 miles and returning to Earth at more than 20,000 mph during Exploration Flight Test-1 on Dec. 5, 2014.



ORION GETS CREATIVE AT ARTSCAPE

In late July, teammates from Orion, the Space Launch System and Ground Systems Development and Operations programs attended ARTSCAPE, the world's largest free arts festival. The festival was held July 21-23, in Baltimore, Maryland. Approximately 15,000 people visited the three programs at Camp Mars, where visitors learned information about the programs and were able to make an Orion capsule and design their own astronaut suit.

FOLLOW THE PROGRESS OF NASA'S NEW SPACECRAFT FOR HUMAN EXPLORATION:

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AUGUST

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