

December 2014 Vol. 1 No. 9

National Aeronautics and  
Space Administration



Kennedy Space Center's

# SPACEPORT

MAGAZINE



**ORION Flight Test**

**Dec. 4, 7:05 a.m.**

# #imonboard



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<http://go.nasa.gov/11r6OeO>



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# KENNEDY SPACE CENTER'S SPACEPORT MAGAZINE CONTENTS

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**Cover:** Orion is scheduled to launch Dec. 4 aboard a Delta IV Heavy rocket to perform the first flight test in space of the spacecraft that is being designed to carry astronauts on exploration missions into deep space. Orion will fly this mission without astronauts and will orbit the Earth twice reaching about 3,600 miles above the planet, 15 times higher than the International Space Station. The spacecraft will re-enter Earth's atmosphere at close to 20,000 mph and splashdown in the Pacific Ocean. For more about the mission, go to [www.nasa.gov/orion](http://www.nasa.gov/orion). Image credit: NASA

**Back:** On Dec. 4, Orion will launch atop a Delta IV Heavy rocket from Cape Canaveral Air Force Station on the Orion Flight Test: a two-orbit, four-hour flight that will test many of the systems most critical to safety. Orion is built to take humans farther than they've ever gone before. Orion will serve as the exploration vehicle that will carry the crew to space, provide emergency abort capability, sustain the crew during the space travel, and provide safe re-entry from deep space return velocities. For more information, go to <http://www.nasa.gov/orion>.

## NASA'S LAUNCH SCHEDULE

**Date:** Dec. 4 - 7:05 a.m. EST  
**Mission:** NASA's Orion spacecraft will launch atop a Delta IV Heavy rocket from Cape Canaveral Air Force Station's Space Launch Complex 37. The Orion Flight Test will evaluate launch and high speed re-entry systems such as avionics, attitude control, parachutes and the heat shield.

**Date:** Dec. 16, 2014 - 2:31 p.m. EST  
**Mission:** Launching from Cape Canaveral Air Force Station, SpaceX CRS-5 will deliver cargo and crew supplies to the International Space Station. It also will carry CATS, a laser instrument to measure clouds and the location and distribution of pollution, dust, smoke and other particulates in the atmosphere.

**Targeted Date:** Jan. 29, 2015  
**Mission:** Soil Moisture Active Passive (SMAP)  
Description: SMAP is an Earth satellite mission designed to measure and map Earth's soil moisture and freeze/thaw state to better understand terrestrial water, carbon and energy cycles. It will launch on a Delta II 7320 from Complex 2 at Vandenberg Air Force Base in California.

# I am KENNEDY SPACE CENTER

National Aeronautics and  
Space Administration



# Frank Repass



I am the range master at the NASA Protective Services Training Range. I'm responsible for all of the security officers' firearms training at the Kennedy Space Center, as well as a variety of outside local, state and federal agencies. I ensure all those I teach are qualified with any firearm they are authorized to carry.

As range master, not only am I a teacher, but I also am responsible for a variety of range-related duties. For example, I make sure all firearms assigned to security police are kept in an operational condition, as well as maintaining all firing ranges, ensuring they are in operational condition. In a given year, I provide more than 200 training opportunities for our uniformed security force, 400 for outside agencies and 600 for our emergency response team.

I also support the Voluntary Protection Program (VPP) Safety program. I have worked for NASA for more than 10 years. Before joining NASA, I was range master and a member of the Orlando Police special weapons and tactics team for 20 years.

The security officers that I train at Kennedy provide a safe work environment for our employees and that makes me extremely proud.

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NASA's Orion spacecraft sits atop a United Launch Alliance Delta IV Heavy rocket Nov. 24 Space Launch Complex 37 at Cape Canaveral Air Force Station (CCAFS) in preparation for its upcoming flight test Dec. 4. The flight test will send Orion 3,600 miles in altitude from Earth on a two-orbit flight intended to ensure the spacecraft's critical systems are ready for the challenges of deep-space missions. For more information, go to [www.nasa.gov/orion](http://www.nasa.gov/orion).

## Orion ready for first test flight

BY STEVEN SICELOFF

Orion's first flight test is expected to be one for the books: the first mission since Apollo to carry a spacecraft built for humans to deep space, the first time NASA's next-generation spacecraft is tested against the challenges of space, and the first operational test of a heat shield strong enough to protect against 4,000-degree temperatures.

From the launch on a gigantic United Launch Alliance Delta IV Heavy on Dec. 4 from Florida to the expected splashdown under billowing parachutes, the mission will test many of the riskiest events Orion will see when it sends astronauts to an asteroid and onward toward Mars in the future.

"Orion is the exploration spacecraft for NASA, and paired with the Space Launch System, or SLS, rocket it will allow us to explore the solar system," said Mark Geyer, program manager of Orion, which is based at Johnson Space Center in Houston.

While the Delta IV Heavy will send Orion on its flight test, SLS will launch the spacecraft on future missions.

The flight test also is a marker for Kennedy Space Center transformation into a multi-user spaceport. The transformation kicked off in 2010 and has made steady progress. This flight represents the center's ability to produce a spacecraft and launch configuration that works well using aspects of the new model for processing and launch.

"The team is enthused, it's good to go flying," said Bob Cabana, director of Kennedy. "It's not just Orion and SLS, you have to tie it all together. It's Orion, it's SLS and it's commercial crew. It's all of that."

NASA's Orion program has arrived at a fulcrum point that will tell its designers and builders how it stacks up technically. It also will show that NASA is ready to take the next step on its journey into deep space – and ultimately to Mars.

So even though Orion is poised for a mere 4.5-hour, two-orbit mission without anyone on board, the cone-shaped craft needs to perform its roster of tasks well, including an all-important descent through Earth's atmosphere and splashdown.

"Really, we're going to test the riskiest parts of the mission," Geyer said. "Ascent, entry and things like fairing separations, Launch Abort System jettison, the parachutes plus the navigation and guidance -- all those things are going to be tested. Plus we'll fly into deep space and test the radiation effects on those systems."

The flight test begins at Space Launch Complex 37 at Cape Canaveral Air Force Station. A 2-hour, 39-minute launch window opens at 7:05 a.m. EST so the launch and recovery of the spacecraft after splashdown can both take place in daylight. Orion will lift off on the strength of a United Launch Alliance Delta IV Heavy, currently the largest rocket in America's inventory.

The boosters on either side of the rocket will fall away about four minutes into the ascent. The center booster with the second stage and Orion on top continues on for about 90 seconds more before its fuel is burned up and it separates to fall back to Earth.

At 17 minutes, 39 seconds following liftoff, the Orion and second stage will be in an initial orbit of 115 miles by 552 miles. The second stage will ignite again two hours into the flight to send Orion through the Van Allen radiation belts and to a peak altitude of 3,609 miles, some 15 times



higher than the space station. This is going to be a key point in the test flight as instruments inside Orion record the radiation doses inside the cabin – critical data for mission planners considering the best way to safely send astronauts into deep space in the future. Orion's cameras will be turned off during its passes through the belts to protect them.

Three hours, 23 minutes into flight, the Orion crew module will fly on its own following separation from its service module and the Delta IV Heavy second stage. The spacecraft will be aimed at Earth's atmosphere and it will be up to Orion's onboard computers to set the spacecraft in the right position so its base heat shield can bear the brunt of the intense re-entry heat.

Hitting the atmosphere at 20,000 mph four hours and 13 minutes after launch, Orion will encounter about 80 percent of the heat it would endure during a return from lunar orbit with astronauts aboard. Ground controllers will lose contact with Orion for 2.5 minutes during re-entry when the spacecraft is surrounded by plasma. They should regain communications with the craft just before the forward bay cover is jettisoned in a process that will begin the parachute deployment. After about four hours, 23 minutes, Orion will be bobbing in the Pacific Ocean off the coast of Baja California as recovery forces move in.

Teams from NASA's Ground Systems Development and Operations Program based at Kennedy will work with U.S. Navy and Lockheed Martin personnel to bring the spacecraft into the well deck of the USS Anchorage, an amphibious ship with a protective enclosure that will allow Orion to basically float onboard without having to be lifted by a crane. A second ship, the USNS Salvor, also will be on hand as a backup.

Many aspects of the mission point to a future as ambitious as any time in NASA's 50-plus-year history.

With lessons learned from Orion's flight test, NASA can improve the spacecraft's design while building the first Space Launch System rocket, a heavy booster with enough power to send the next Orion around the moon for Exploration Mission-1. Following that, astronauts are gearing up to fly Orion on the second SLS rocket on a mission that will return humans to deep space for the first time in more than 40 years. These adventures will set NASA up for a future human missions to an asteroid and even on the journey to Mars.

"To be able to even think about going to an asteroid and to be able to think about this kind of exploration, that's very exciting," Cabana said. "I think there's a genuine, positive atmosphere, and I don't think it's confined to just Kennedy. You go across all the NASA centers and I think the team is really excited about the future."

And while all that work is happening on the ground, astronauts on the International Space Station will continue the groundbreaking research that is already adding to humanity's understanding of everything from long-duration spaceflight to the continued experimentation on products and processes that improve life on Earth.

None of those plans has caused NASA or Lockheed Martin, which is operating this flight test, to look past the crucial steps needed to make this mission a success.

Lockheed Martin assembled the spacecraft in the high bay at Kennedy.

While the mission is expected to make a huge impact on the way the next Orion is built, many lessons from the buildup of this spacecraft are already being incorporated in the planning for the next one, Geyer said.

Geyer added, "This has shown it's a good design, it's a good mission and now it's time to go fly."

## 'O' is for ORION



### Flight Test to carry mementos, inspirational items

NASA and Sesame Street have joined forces to help promote the importance of studying science, technology, engineering and math (STEM) and teach students about the importance of human spaceflight. Cookie Monster's cookie, Ernie's rubber ducky, Slimey the Worm and Grover's cape will soar through space again aboard Orion as NASA's next-generation spacecraft makes its first flight test Dec. 4. The precious cargo will fly some 3,600 miles above Earth and come back to take prized spots on the Sesame Street set where millions of children will watch.

Also aboard will be an oxygen hose from an Apollo 11 lunar spacesuit. That artifact from the historic first moonwalk in July 1969 is part of a manifest of mementoes and historically significant items that will fly in Orion and hint at the spacecraft's future of discovery.

The flight test also will carry several items that will be used to inspire future generations.

To read the complete story, visit <http://go.nasa.gov/1uX16Ny>

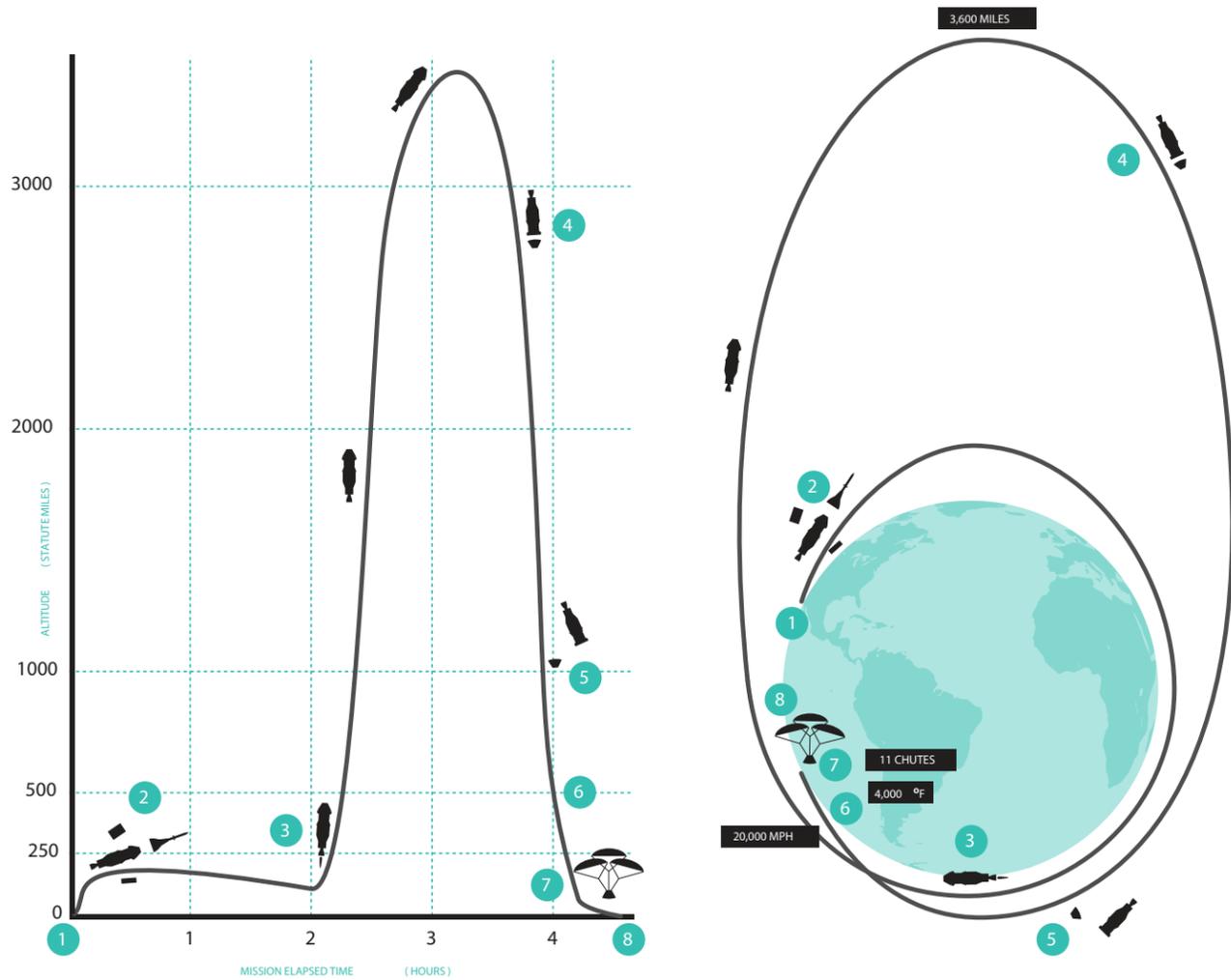
a look online

more online



# ORION

## FLIGHT TEST



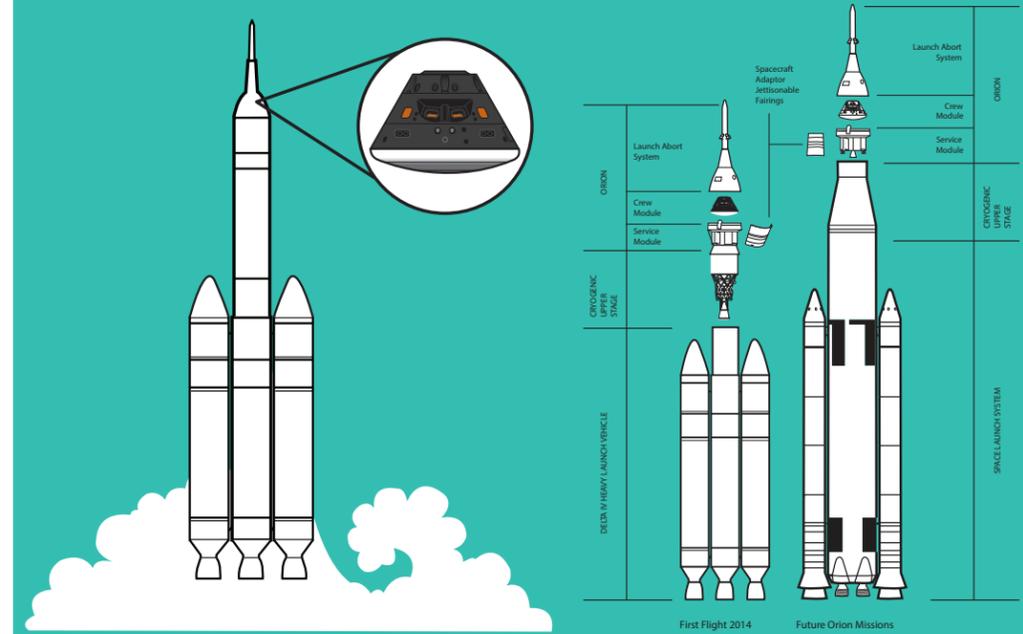
### THE FLIGHT

Orion's first flight test in December is a critical and significant step toward sending humans farther into space than ever before. This test will evaluate launch and high speed re-entry systems such as avionics, attitude control, parachutes and the heat shield.

1

0:00:00

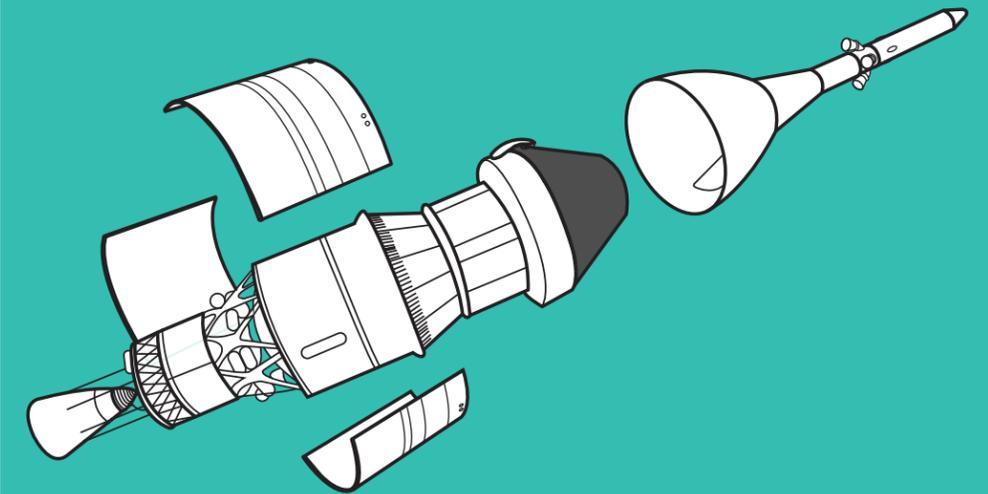
Orion Launches on the ULA Delta IV Heavy rocket from Florida



2

0:06:15

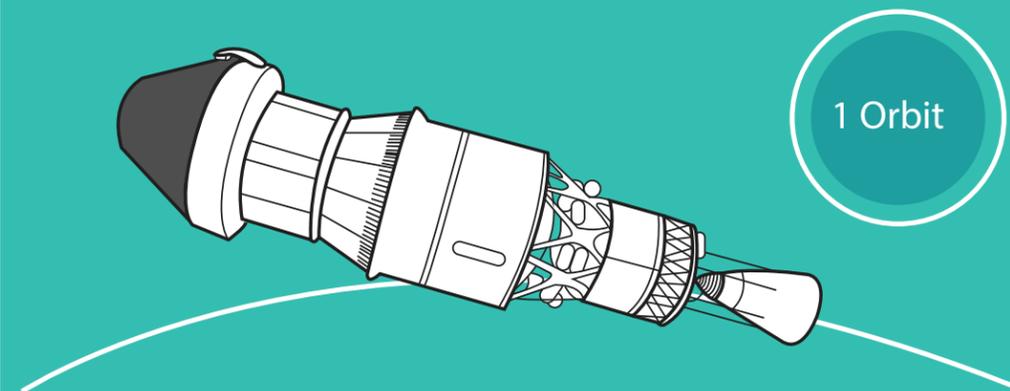
Service Module fairings and the Launch Abort System Separate



3

1:57:11

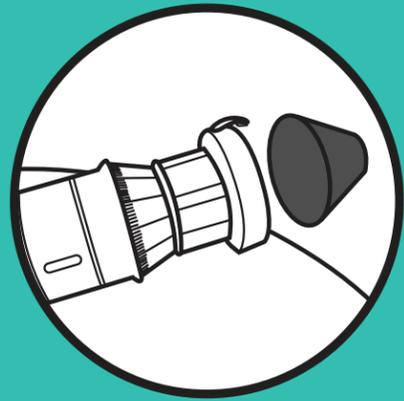
Upper Stage reignites after completing one orbit



4

3:23:41

Crew Module separates from Service Module and Upper Stage

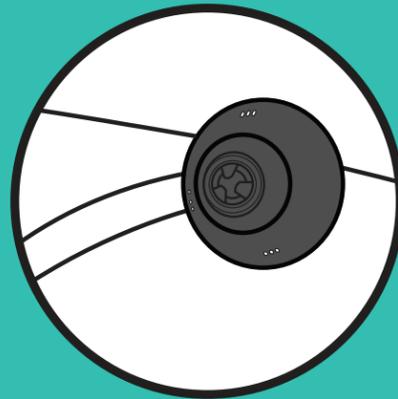


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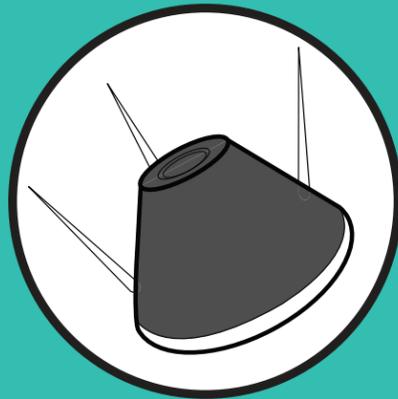
3:57:00

Crew Module performs the raise burn to orient correctly for re-entry

CAPSULE ORIENTATION



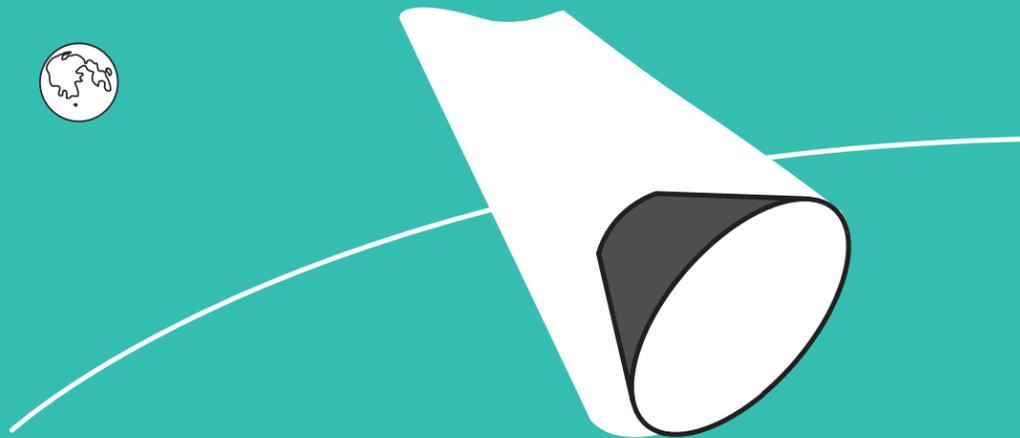
CONTROL JETS FIRE



6

4:13:41

Crew Module makes contact with the atmosphere

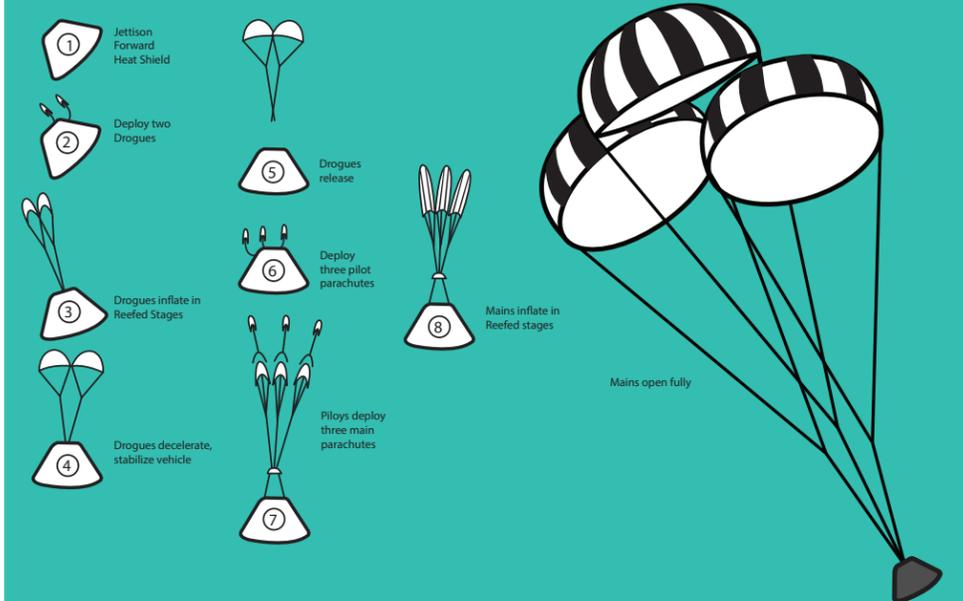


BLACKOUT

7

4:20:22

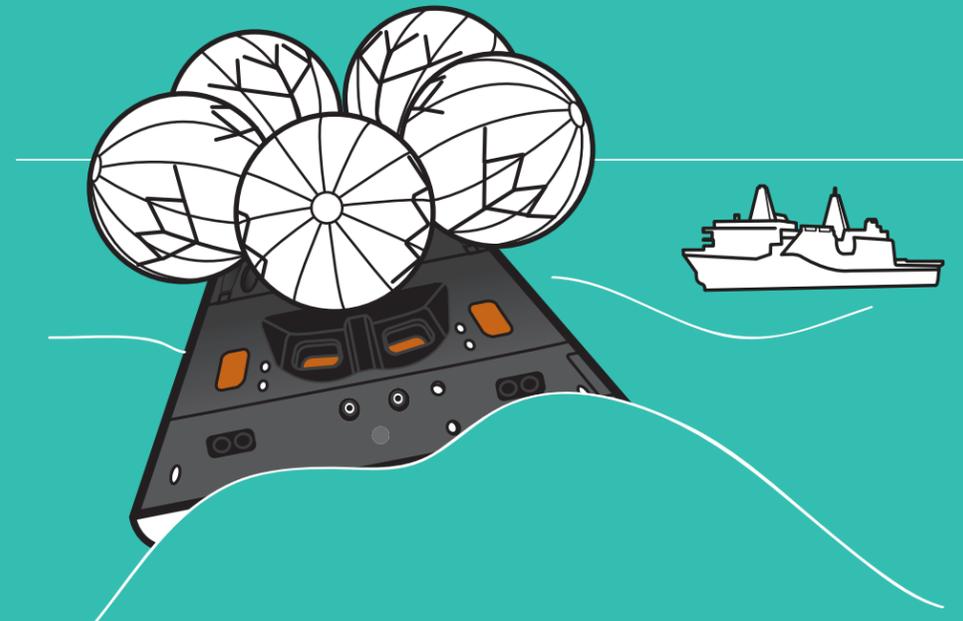
Forward Bay Cover separates starting the parachute deployment sequence



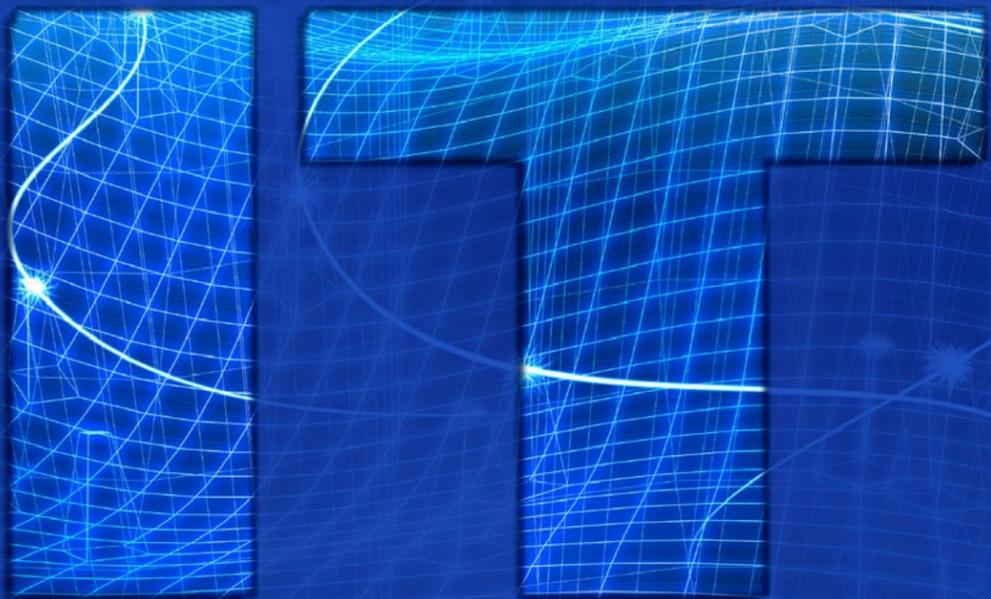
8

4:24:46

Orion lands safely in the Pacific Ocean and is recovered by NASA and the US Navy



# Evolution of



## Kennedy's IT Advance Concepts Lab is changing the way IT is done

BY FRANK OCHOA-GONZALES

Kennedy Space Center's IT Advanced Concepts Lab (ITACL) is leading the evolution of IT and turning yesterday's science fiction into today's science fact. The group possesses a diverse skill set of developers, leaders, designers and modelers. They combine revolutionary technologies with NASA needs to create futuristic tools for space exploration.

"Sometimes you have to see it to believe it," said Tracey Kickbusch, Computational Sciences Branch chief with NASA IT. "You try to explain things to people and they don't get it until they see it." So that's what the Advanced Concepts Lab team is doing -- showing the data instead of talking about it. "When everyone sees the same picture, everyone has the same understanding." The ITACL portfolio is as diverse as the people involved. Several projects are in work, with a few of them shared here.

## SPACEPORT KSC APP



The Spaceport KSC application is a great example of game technology meeting NASA needs. While Distributed Observer Network (DON) brings rich simulation environments to the desktop, and the Desert RaTS Virtual Tour brought architecture and terrain information to the tablet, Spaceport KSC brings detailed information on Kennedy Space Center and Cape Canaveral's launch sites and systems to a touch enabled computer by providing a 3-D map of Kennedy and Cape Canaveral Air Force Station with facilities, launch systems and vehicles. It works on the iPad and touch surface computers, such as a touch table and touch screen.

The user can select the facility for a close-up view and in some cases can see a high-level interior view. In the information panel of each facility, the user can learn more about the

facility, see photos, watch videos, and soak up interesting facts and trivia. If the facility processes a vehicle (such as the Vehicle Assembly Building or a launch pad), the user can get a close-up look of the rocket and learn about its different components.

The goal is for SpacePort KSC to travel and show people what we do and where we do it. This app includes information from the new KSC Master Plan and is being developed for the Ground Systems Development and Operations Program, the Launch Services Program, and Center Planning and Development.

As a result, it has additional features such as KSC's current and planned land use and it identifies how facilities will be used (multi-use, government exclusive use, non-government use).

# OCULUS RIFT



Oculus Rift is a new commercial technology that currently is in prototype form. It is a new virtual reality headset that allows the user to step inside their favorite games and virtual worlds.

It was developed with the computer gaming market in mind, but its applications can go beyond that.

“We’re exploring the best way to utilize them,” Kickbusch said. “We are investigating the potential of this technology and how it can supplement our current product areas as well as lead to new areas that can be useful to NASA’s programs.”

“It’s very experimental right now, it’s an emerging technology.”

The headsets do have names . . . Larry, Curly, Moe and Shemp.

The Oculus Rift uses custom tracking technology to provide ultra-low latency 360° head tracking, allowing the user to look around the virtual world as they would in real life. Every subtle movement of the user’s head is tracked in real time creating a natural and intuitive experience.

# THE DISTRIBUTED OBSERVER NETWORK (DON)

Simulation technologies are in play in every NASA program across every phase of every system lifecycle. Design teams model systems, components and facilities to see how they look, simulate them to see how they behave and study the results to decide what to do next. They repeat this cycle as many times as necessary to get things right and then share the conclusions with others. Using tools that vary from massively parallel computers to Microsoft Excel, NASA develops immersive representations of spaceflight, computational physics, process studies, system visualizations and work processes. These simulations run on supercomputers, networks of computers, or workstations everywhere at NASA.

Until recently, the results of these simulations were typically confined to the machines that ran the simulations or a report. During the Constellation Program, NASA developed a way to share and distribute this rich simulation data as well as the necessary interface language to connect this new capability to the simulators themselves. The Distributed Observer Network (DON) was the distribution tool and the Model Process Control (MPC) format was the transitional language that enabled the simulators to communicate with DON.

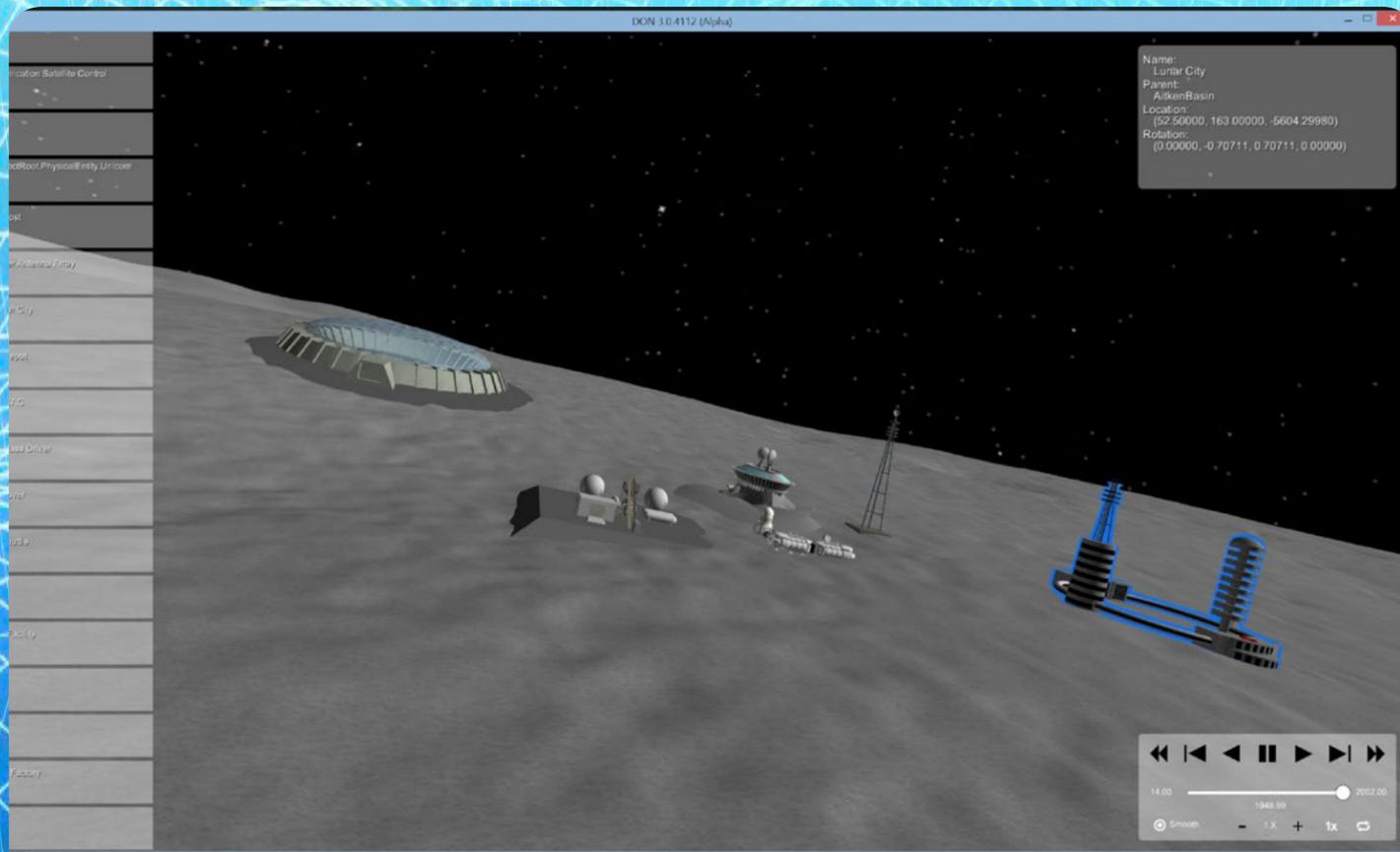


# VIRTUAL CONTROL PANEL

Virtual Control Panel started as a KickStart funded project following a successful pitch at the 2012 KSC Innovation Expo and has grown significantly since. VCP uses Microsoft Kinect's motion sensing technology to track a user's movements. Virtual Reality head mounted displays allow the user to interact with a software-generated control panel designed to convert hand gestures into commands to operate a remote robotic device. This capability can be useful in a number of areas, especially when operating in hazardous operations in hostile environments.

In addition, it can have applicability in areas ranging from controlling presentations in a conference room to remote "tele-control," which is the ability to control something from a distance with just gestures.

"It's always a challenge trying to see how one can control the physical without using physical. It's not real there, we're just trying to make it real," Kickbusch said.



Today, version 3 of DON addresses these same needs, but with a modern game core, a new user interfaces and an enhanced version of MPC. Prerelease versions already have supported the 2013 Simulation SmackDown event (an international student project simulating a lunar base) and served as the basis for prototypes such as the GSDO (Ground Systems Development and Operations) Glass Wall. DON 3 combines the best of the Unity multiplatform game development environment with touch controls, gesture controls and version 3 of NASA's MPC data standard. The result is a modern, immersive simulation distribution, archive and analysis capability that supports NASA's exploration activities as well as student projects, outreach and education. Future capabilities in the area of multiplayer analysis and distributed data management will arrive in 2015, as well as integration with advanced devices such as the Oculus Rift.

DON 3 will be available as NASA released software this month on the PC with support on the MAC for select features.



# SEE (Simulation Exploration Experience)

SEE is a STEM education outreach effort culminating in an annual, international student competition. SEE is an effort to promote an understanding to the importance of modeling and simulation -- especially standards and interoperability -- among high school and college students. The event combines international standards, corporate sponsors, instructor-led curricula, NASA tools and NASA mentors to create a simulated lunar settlement.

SEE strives to foster networking, employability, and job readiness within this burgeoning and recession-proof industry. SEE is an international, intercollegiate cooperative effort that offers real model and simulation experience with the help of academia, professionals within the industry, NASA, and other areas of government through participation in a simulated re-supply mission to the moon. SEE has a website at <http://www.exploresim.com>.



# 3D SCANNING/PRINTING

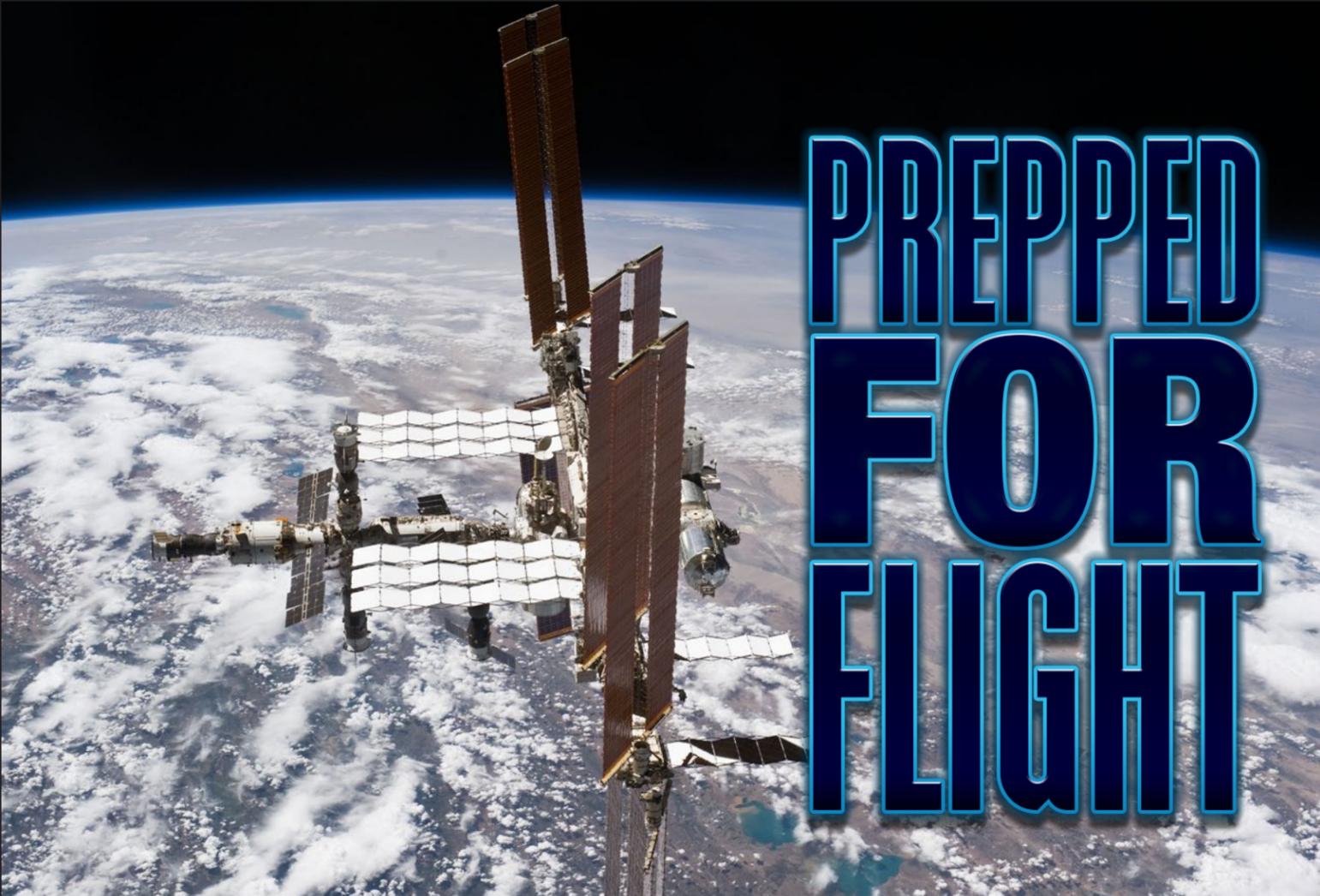


A 3-D printer designed to operate in microgravity was just sent to the International Space Station as part of SpaceX CRS-4 and the recent 3-D Printing in Zero-G Technology Demonstration (3-D Printing In Zero-G) experiment demonstrated that a 3-D printer works normally in space. Testing a 3D printer using relatively low-temperature plastic feedstock on the International Space Station is the first step towards establishing an on-demand machine shop in space. This hardware will increase on-station capabilities which will be important for future ISS expeditions and eventually long-duration spaceflight missions. Here on Earth, IT has been investigating desktop 3-D printing and scanning for a number of years with the goal of providing it as a service to the multiple organizations at Kennedy. This new technology has the potential to revolutionize how we do work at the center and is a way for IT to bring the intangible nature of our modeling work into the tangible nature of a physical 3-D object. IT is finishing work on a 3-D printing lab, with systems and training that will be open to badged employees. 3-D printers, software tools, training and computers will be available to help users better understand the benefits and pitfalls of the technology. A new 3-D printing community of interest is available in the Kennedy Forum to support this community (<https://forums.ksc.nasa.gov>).

# DESERT RATS VIRTUAL TOUR

The past decade has seen significant global investment in consumer video game technologies, capabilities, and peripherals. The IT Directorate at Kennedy leveraged this investment in 2011 with the Desert RaTS (Research and Technology Studies) Virtual Test Site (released on Android and iOS). This application brought the user to the Black Point Lava Flow test site in Arizona. The user was able to explore the test site, collect achievement badges along the way and gain access to detailed information on the test elements through hyperlinks to published information. This application was developed in partnership with Analytical Mechanics Associates at Langley Research Center and released to iTunes and the Android market during the event.





# PREPPED FOR FLIGHT

## Research experiments ready for SpaceX CRS-5 mission

BY LINDA HERRIDGE

Two of the plant experiments riding to the International Space Station (ISS) on SpaceX's fifth commercial resupply mission later this month began their voyage inside the Space Station Processing Facility (SSPF) at Kennedy Space Center. The experiments will help advance knowledge in the physical and biological sciences that in turn could benefit humans on Earth as well as astronauts on long-duration space missions.

The Advanced Plant EXperiments on Orbit (APEX) 3 and Biological Research in Canisters (BRIC) 20 were prepared in laboratories inside the SSPF. They will be loaded in SpaceX's Dragon capsule just a few days before liftoff.

Once they have been delivered, crew members aboard the space station will follow a set of procedures to activate and monitor the experiments and prepare them for return to Earth.

Both experiment series are sponsored by the Space Biology Program to help investigate how cells, plants and animals respond to changes in gravity. The program is managed by the Space Life and Physical Sciences Research and Applications Division in NASA's Human Exploration and Operations Mission Directorate.

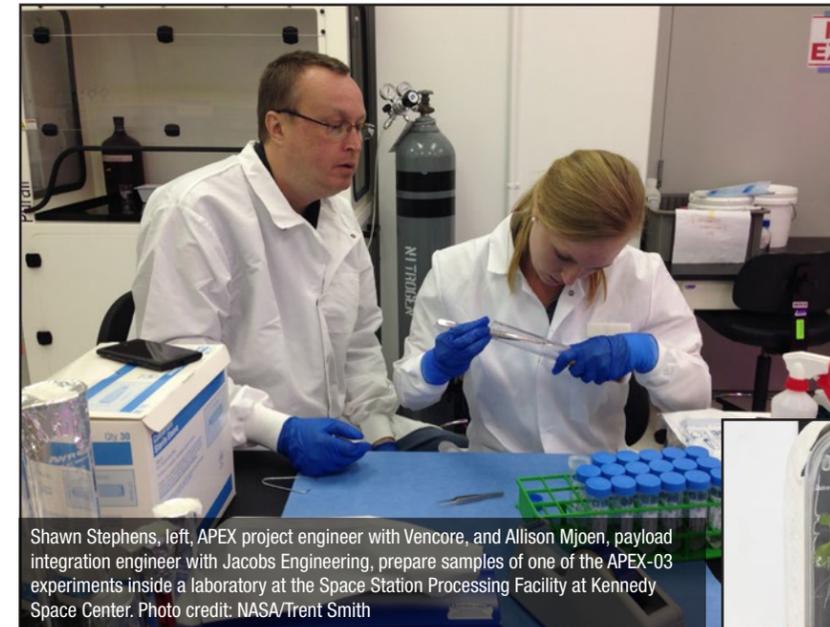
"We are sending plants into space to better understand how they respond and adapt to spaceflight, which will give us insights into building better crops on Earth as well as what we can anticipate as we step out into the solar system on our way to Mars," said Trent Smith, NASA APEX project manager.

Included in the Kennedy team's responsibilities were preparing the laboratories, equipment and supplies for the investigator teams, the experiment monitoring area for mission support and the ISS Environmental Simulator (ISSES) chamber for ground control

facility for up to 11 days. The light microscopy module, a modified commercial imaging microscope facility on the station, will be used to more closely inspect and map root structure and the location of green fluorescent genes in the plants.

For both experiments, the seedlings will be photographed, harvested and preserved with a chemical fixative in Kennedy Fixation Tubes and returned to Earth on the same Dragon capsule for post-flight evaluation.

Allison Mjoen, a payload integration engineer, led science development activities and was the

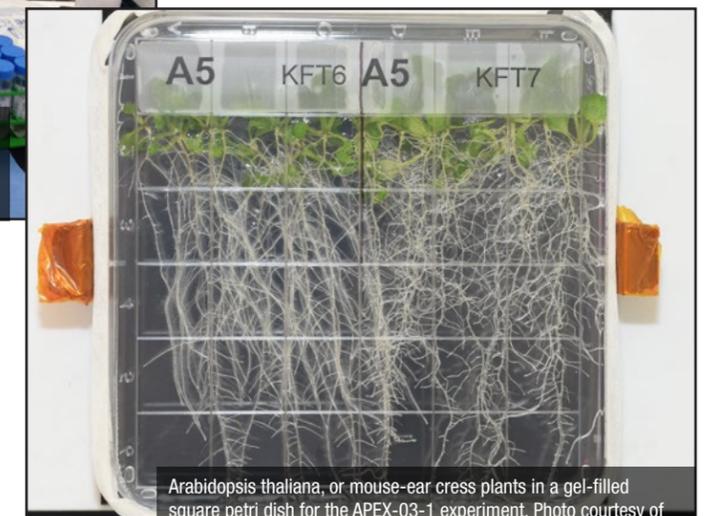


Shawn Stephens, left, APEX project engineer with Vencore, and Allison Mjoen, payload integration engineer with Jacobs Engineering, prepare samples of one of the APEX-03 experiments inside a laboratory at the Space Station Processing Facility at Kennedy Space Center. Photo credit: NASA/Trent Smith

testing in the SSPF. The team also performed payload and science verification tests and sent samples to the principal investigators to confirm viability.

APEX-03 actually is two experiments that will be activated in the Veggie plant growth facility already on the space station. The first, APEX-03-1, will study microgravity's impact on root development and cell walls of plant seedlings. For this experiment, *Arabidopsis thaliana* seeds, also called cress-ear, were placed in petri plates filled with a gel-like growth medium called agar.

In the second experiment, APEX-03-2, *Arabidopsis thaliana* seedlings were placed in agar-filled petri plates to study the effects of microgravity on the DNA of plant roots in a spaceflight environment. Aboard the space station, the seedlings will be placed in the Veggie



*Arabidopsis thaliana*, or mouse-ear cress plants in a gel-filled square petri dish for the APEX-03-1 experiment. Photo courtesy of Dr. Elison Blancaflor, principal investigator with the Noble Foundation

primary interface with the principal investigator teams for the APEX-03 experiments.

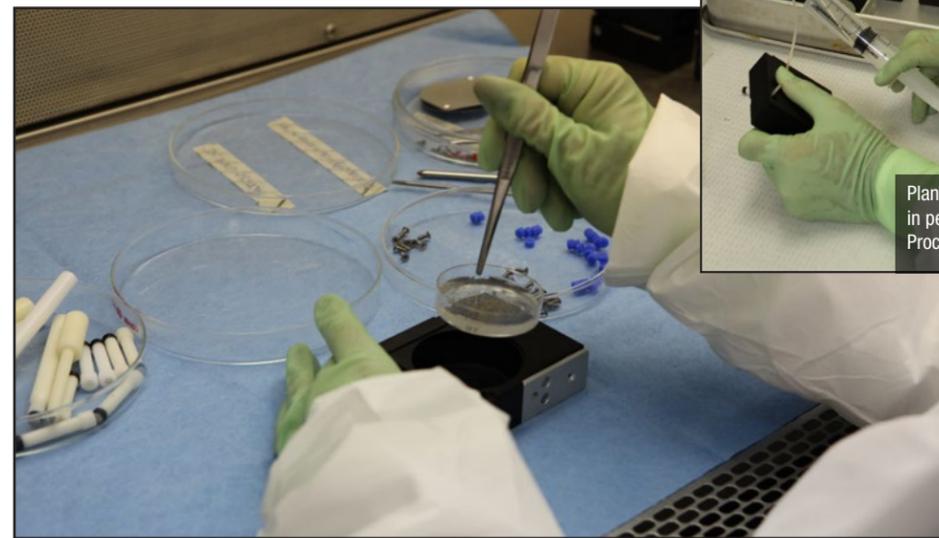
"It is a tedious yet rewarding process to prepare a payload to fly to and operate on the space station," Mjoen said. "The research the investigator teams are conducting have implications for improving agriculture and biomass production here on Earth."

Preparations for APEX-03 were not without challenges. According to Shawn Stephens, APEX project engineer, Veggie had to be verified

that it could function as a science platform that could support both experiments because the Advanced Biological Research System facility currently on the space station was not available to support them. Also, Kennedy worked with a team at NASA's Glenn Research Center in Cleveland to acquire a light microscopy module unit that could be used during the ground control experiment in the ISSSES chamber.

Before the APEX experiments are prepared for stowage in the Dragon capsule, they will be wrapped in protective foil and placed in flame-retardant Nomex kit bags. The bags will keep the plant samples as fresh as possible for the ride to the space station.

"I consider it an honor to work with the talented science investigation teams to prepare for this exciting mission," Stephens said. "I don't



think it would have been as fun without all of the challenges we overcame."

While Expedition crew members work with the APEX experiments on the space station, a "pseudonaut" at Kennedy will be following the same procedures on identical plant samples in an ISSSES chamber in the SSPF that mimics as close as possible the conditions on the space station, except for gravity.



Plant samples for the BRIC-20 experiments are prepared in petri dish fixation units in a lab inside the Space Station Processing Facility. Photo credit: NASA/Dimitri Gerondidakis

The BRIC-20 experiment consists of four canisters with 22 petri dishes containing approximately 800 *Arabidopsis thaliana* seeds atop a growth medium. On Dec. 14, the team will

integrate the petri dishes into the petri dish fixation units, and then into the BRIC canisters.

"Our BRIC team is a high-energy, experienced team capable of meeting any challenge that comes our way," said Susan Manning-Roach, BRIC project engineer and task leader for preparing and assembling the hardware as well as the integration of the science specimens into a sterile enclosed environment.

BRIC-20 will study the underlying molecular mechanisms of microgravity and how it impacts plant growth and development. This research has the potential to aid in better design of plants for bio-regenerative life support during spaceflight.

The seeds will be kept cold until they are unpacked after delivery to the space station. On the space station, a three-day growth period will allow the seeds to germinate. Then the seedlings will be preserved and placed in a cold storage unit that maintains experiment samples at ultra-cold temperatures throughout a mission until its return to Earth and the principal investigators.

David Flowers, the NASA BRIC project manager, said in spite of several challenges while preparing the hardware and samples for

the mission, the team was able to complete its preparations in just seven months. In comparison, BRIC-17 required 22 months to prepare for SpaceX's third commercial resupply mission to the station earlier this year.

Challenges included damage to the science verification test specimens during shipping, actuator tool anomalies, a failed payload verification test germination and the performance of an unplanned test to identify the contributing factors to the failure.

"We've learned some very good lessons and applied these lessons quite effectively," Flowers said. "We've put Kennedy's greatest assets on display -- delivering hardware on schedule, getting the job done on budget, and having the hardware function as intended."



Inside a lab at the Space Station Processing Facility, technician Jim Smodell prepares to load a set of petri dish fixation units for the BRIC-20 experiments into a vacuum chamber for a leak test. Photo credit: NASA/Dimitri Gerondidakis



Gideon Gidori, foreground, and other students from Florida Air Academy listen to experts on spaceflight at Kennedy Space Center. Photo credit: NASA/Kim Shiflett

# SHOOT FOR THE STARS

**Goal of becoming an astronaut brings Tanzanian teen to Space Coast**

BY BOB GRANATH

For more than a half century, people around the world have been inspired as humans traveled to Earth orbit and the moon. Many young people now dream of becoming space explorers – even in the most remote areas of our planet.

Many students living in the Arusha region of the east African nation of Tanzania do not go beyond primary school. Gideon Gidori was only seven years old when he decided he wanted to become an astronaut. However, he knew that would require much more education and training. With the help of a village school founder, a Brevard County-based philanthropic organization and a private school, opportunities now are opening for Gidori that would have been unthinkable a few years before.

In the fall of 2009, at age 11, Gidori wrote about his desire to become a space traveler on his Web blog, “Shoot for the stars -- Adventures of an aspiring astronaut.”

“I would like to be an astronaut when I grow up and see the moon by my two eyes,” he said. “I will do anything

to study hard, or whatever, to achieve my goal.”

Now age 15, Gidori is a student at Florida Air Academy where his classes include pilot’s lessons and an opportunity to hear from experts on spaceflight at Kennedy Space Center.

On Oct. 29, Gidori and his sophomore class of 28 students from Florida Air Academy participated in a program at the NASA Educator Resource Center, operated by the Astronauts Memorial Foundation. According to Andrea Cann, Education Programs coordinator at

the center, the program included a one-hour science workshop in addition to guest speakers who provided insight into some of the career opportunities available at Kennedy.

“Many of the students at Florida Air Academy are foreign nationals with diverse backgrounds,” she said. “We hope this experience of hearing from our speakers and touring the visitor complex will inspire all of the students to continue to work toward their personal goals.”

One of the guest speakers, Rachel Hardy, a mechanical engineer in Kennedy’s Swamp Works laboratory, said that she and others are working on ways future astronauts may live off the land as they explore beyond Earth.

The agency’s Lunar Reconnaissance Orbiter and the Lunar Crater Observation and Sensing Satellite have located potential resources just below the moon’s soil. Hardy and other engineers and scientists are now working on a project called the Regolith Advanced Surface System Operations Robot. RASSOR is a prototype of a mining robot designed to dig and deliver lunar regolith (moon dirt) to a processing plant that would pull oxygen out of the soil or excavate a landing pad for future landers.

Former NASA astronaut Robert Springer related



Former NASA astronaut Robert Springer, left, stresses the value of education to Gideon Gidori, who is considering a career as an astronaut. Photo credit: NASA/Kim Shiflett

experiences during his two space shuttle missions in 1989 and 1990.

“We did a lot of science up there,” he said. “The science experiments that we did on board the shuttle were in the proof-of-concept stage. It proved we could do the kinds of things we are doing today on the International Space Station.”

A 1964 graduate of the United States Naval Academy and a retired U.S. Marine Corps colonel, Springer stressed the value of education, especially for those considering a career as an astronaut.

“This is rocket science,” he said. “You still have to have as a minimum a Bachelor of Science degree in a technical field – science, technology, engineering or mathematics. Most astronauts have advanced degrees and many have Ph.D.s.”

For Gidori, his dreams began far from modern-day technology.

He grew up in a Tanzanian village near some of Africa’s most famous landscapes and national parks, including the Serengeti and Mount Kilimanjaro. The village is in a remote location in the northern part of the country near the border with Kenya. While his early education was lacking in resources, it was helped with the assistance of a local woman known as “Mama Lucy.”

Concerned about the lack of educational opportunities for children in her village, Lucy Kamptoni started a school in 2003 with only six pupils. By selling chickens, she raised money to expand to 120 students.

In many cases, there was only one textbook available for a class. Students needed to copy class notes and memorize the information. While Swahili is the primary language in Tanzania, fortunately for Gidori, English also is taught in most of the nation’s schools and both are considered official languages. These lessons would prove crucial for the aspiring astronaut when an opportunity soon came his way.

In 2007, Kamptoni met volunteers from the Satellite Beach, Florida-based nonprofit organization, Epic Change.

According to the organization’s website, they were successful in helping raise additional funds so that “Mama Lucy’s school now employs more than 60 staff and serves more than 600 children on three campuses in Moivaro, Kimandolu and Manyire, Tanzania. Students have access to science and tech lab facilities, libraries, a school farm, boarding facilities and more.”

Epic Change also awarded Gidori a scholarship to cover part of his cost to attend Florida Air Academy in Melbourne, Florida. The academy is a co-educational, college preparatory school for grades six through 12. Their students represent more than 20 U.S. states and 23 countries.

The diversity of the Florida Air Academy student body is part of what Gidori likes best.

“I have met with people from different parts of the world with different cultures,” he said. “I have come in contact with students my age, younger and even older who are such good friends.”

Now in his second year at Florida Air Academy, Gidori noted in September of this year that he is enjoying his experience.

“It’s the first couple weeks of school and things



Students from Florida Air Academy listen to former NASA astronaut Robert Springer during a program at the Astronaut Memorial Foundation’s Educator Resource Center at Kennedy’s Visitor Complex. Photo credit: NASA/Kim Shiflett

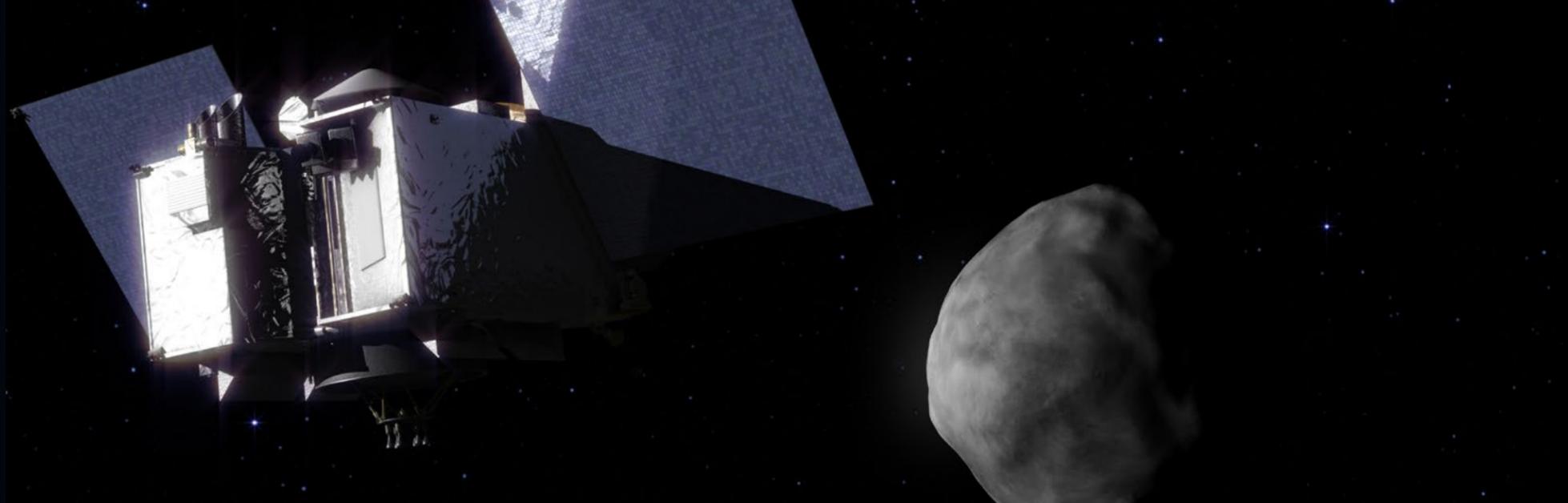
are a little challenging, but that’s what school is all about, being challenged,” he said. “I’m totally loving it.”

Gidori’s courses at school now include learning to fly.

“I’ve started to take flight lessons, which are extremely fun,” he said. “I get to fly a plane and get a pilot’s license by the time I graduate.”

With his recent experience at Kennedy and as a student at Florida Air Academy, Gidori now believes his opportunities are boundless.

“It makes me feel free, loved, cared for,” he said. “It makes me see my future already, makes me feel that I can make it anywhere.”



This is an artist's concept of NASA's OSIRIS-REx asteroid sample-return spacecraft arriving at the asteroid Bennu. Image credit: NASA's Goddard Space Flight Center Conceptual Image Lab

## New animation follows long, strange trip of Bennu -- target of NASA's asteroid sample return mission

**B**orn from the rubble of a violent collision, hurled through space for millions of years and dismembered by the gravity of planets, asteroid Bennu had a tough life in a rough neighborhood: the early solar system. "Bennu's Journey," a new animation created at NASA's Goddard Space Flight Center in Greenbelt, Maryland, shows what's known and what remains mysterious about the life of Bennu and the origin of the solar system.

"We are going to Bennu because we want to know what it has witnessed over the course of its evolution," said Edward Beshore of the University of Arizona, deputy principal investigator for NASA's asteroid sample-return mission OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, Security – Regolith Explorer). The mission will be launched toward Bennu in late 2016, arrive at the asteroid in 2018, and return a sample of Bennu's surface to Earth in 2023. "Bennu's experiences will tell us more about where our solar system came from and how it evolved. Like the detectives in a crime show episode, we'll examine bits of evidence from Bennu to understand more completely the story of the solar system, which is ultimately the story of our origin."

**For the full story or to download the movie in various formats, go to <http://go.nasa.gov/1xr77CU>**

This is an artist's concept of the impact that created the asteroid Bennu. Scientists think Bennu formed when some of the rubble from a collision like this coalesced under its own gravity. Image credit: NASA's Goddard Space Flight Center Conceptual Image Lab



# MONUMENTAL MODIFICATIONS

175-ton crane undergoes upgrades for future launch vehicle processing

The 175-ton crane is lowered by crane Sept. 18 onto steel work stands on the transfer aisle floor of the Vehicle Assembly Building at Kennedy Space Center. Photo credit: NASA/Daniel Casper

BY LINDA HERRIDGE

It was no small feat to lift and stack heavy Saturn V rocket segments and space shuttle components. Some spacecraft components could weigh as much as 190 tons and had to be lifted as much as 460 feet high. The right tool for the job? Large cranes in the Vehicle Assembly Building (VAB) at Kennedy Space Center. The agency has successfully accomplished these processing tasks since the late 1960s.

Now, one of the cranes that sits across the massive building's transfer aisle, the 175-ton bridge crane, is undergoing modifications and upgrades so it can support lifting needs for future exploration vehicles, including NASA's Space Launch System and Orion spacecraft.

Operating the VAB cranes is a specialized field. Kennedy's crane operators are required to go through about a year of extensive in-house training and achieve a 094-1 Overhead Crane Operator Certification. They must be able to demonstrate proficiency in all positions on the crane crew, including crane cab controls, ground controller and e-stop operator.

Precision is the key when moving, lifting or stacking launch vehicle components. The cab controls are used to move the crane and its load forward, backward and sideways, in any direction as little as 1/64th of an inch.

"Our most experienced technicians started in the early 1980s during the Space Shuttle Program," said Tiffany Osborne, the overhead cranes, doors and logistics equipment supervisor on the Test and Operations Support Contract.

Osborne said the ground controller follows the load and gives the movement commands to the operators in the cab. The e-stop operator works with the ground controller to provide an extra safety function and has the ability to cut power to the crane in case of an emergency or loss of communication between the operators in the cab and the ground controller.

The 175-ton crane, two 250-ton cranes, and several other smaller cranes and hoists were original equipment when the VAB was constructed. The two 325-ton cranes were added in the early 1990s. The 175-ton crane was one of the cranes used to stack the Saturn V rocket for the Apollo 11 mission to the moon. It also was used to rotate the space shuttle from the horizontal to the vertical position for hoisting into position on the mobile launcher platform alongside the external fuel tank and solid rocket boosters.

"There's a lot of history here with the cranes in the VAB," said Larry Jones, a lifting equipment system engineer in Ground Processing at Kennedy. "They are great machines."

Jones began working at Kennedy in 1987 and has specialized in cranes and lifting devices at the center ever since. He was in the VAB on Sept. 18 and watched as a 325-ton crane located about 400 feet above the ground began to lower the 175-ton crane from its location at Level 16, about 160 feet from the ground.

But first, construction workers removed a portion of the railing and walkway on either side of the 114-foot-wide transfer aisle so the crane operator could lift up and turn the bridge crane at about a 90-degree angle to gain clearance. Then the crane was slowly lowered onto steel support structures positioned on the ground floor of the transfer aisle.

Technicians and crane specialists with Advanced Crane Technologies in Redding, Pennsylvania, got busy removing the original cab that was used to operate the crane.

The cab's 45-year-old remote control system, cabling and wiring will be upgraded to improve its reliability, precision and safety.

Components of the crane include the bridge girders, trolley, main and auxiliary hoisting units and the motion driver. The crane's bridge traverses north and south along the full length of the transfer aisle, while its trolley runs east and west. It has a hook height of 166 feet.

New bearings recently were installed on the inner and outer wheels of the trolley. Lead paint abatement and asbestos removal is in progress on the crane and crane cab. Modifications to walkways and ladders will be completed to comply with Occupational Safety and Health Administration requirements.

Steve Starr is a senior project manager with Vencore on the Engineering Services Contract. He supports the VAB project management team for all development work in the iconic building, which includes the crane modifications.

Upgrades to the crane are scheduled to be completed by March 2015. The two 325-ton cranes were upgraded several years ago. Starr said preliminary designs are in place for future upgrades to the two 250-ton cranes.

Starr said, "It is rewarding to see the construction modifications taking place in the transfer aisle of the VAB after an extended period of design and planning."

The 175-ton crane is turned as it is lowered by crane from Level 16 on Sept. 18 down to the transfer aisle floor inside the Vehicle Assembly Building at Kennedy Space Center. Photo credit: NASA/Daniel Casper

# IN REMEMBRANCE



Above: Flowers and photographs of test pilot and astronaut Theodore Freeman stand near his name on the National Space Mirror Memorial at the Kennedy Space Center Visitor Complex on Oct. 31. Photo credit: NASA/ Dimitrios Gerondidakis

## Ceremony honors Freeman with 50<sup>th</sup> anniversary memorial

BY BOB GRANATH

The Astronauts Memorial Foundation and leaders at Kennedy Space Center paused recently to remember Theodore Freeman, the first American astronaut to lose his life in service to the space program.

Oct. 31, 2014, marked the 50th anniversary of Freeman's loss. The remembrance took place at the Space Mirror Memorial at Kennedy's visitor complex.

The memorial included remarks by state Sen. Thad Altman (R-Brevard and Indian River counties), who serves as president of The Astronauts Memorial Foundation. The organization is a private, nonprofit organization that built and maintains the Space Mirror Memorial.

"It is important that we honor the brave men and women who gave their lives in the pursuit of human space exploration so that we can preserve their legacies and carry on their dreams," Altman said.

The Astronauts Memorial Foundation honors and memorializes those astronauts who have sacrificed their lives for the nation and the space program by sponsoring the national Space Mirror Memorial and by implementing innovative educational technology programs.

Also participating in the ceremony were Kennedy's associate director, Kelvin Manning, former NASA Astronaut Jon McBride, and Freeman's daughter, Faith Johnson.

"You do repay the debt to us by being here," said Johnson. "You repay it with this memorial that other people can see."

The service also included a ceremonial honor guard from the 45th Space Wing at Patrick Air Force Base, presentation of colors by officers of the Brevard County Sheriff's Office and a memorial flyover by an F-104 jet from Starfighters Aerospace.

Altman asked guests to join together in a moment of silence at 10:01 a.m., the minute when Freeman's last flight departed the McDonnell-Douglas training facility in St. Louis, Missouri, where the Gemini spacecraft were being built.

Project Gemini was the program that bridged from NASA's first human spaceflights to the Apollo moon landing efforts. The 10 missions included the first spacewalks, spacecraft rendezvous and longer duration missions.

On the morning of Oct. 31, 1964, Freeman was piloting a T-38. While



Kennedy Space Center Associate Director Kelvin Manning addresses those in attendance at the ceremony Oct. 31 honoring astronaut Theodore Freeman. Seated behind him are, from the left, state Sen. Thad Altman, who serves as president of The Astronauts Memorial Foundation, Freeman's daughter, Faith Johnson, and former NASA astronaut Jon McBride. Photo credit: NASA/ Dimitrios Gerondidakis

approaching the runway at Ellington Air Force Base, near the Manned Spacecraft Center (now Johnson Space Center) in Houston, a large Canadian goose struck the jet's canopy.

Astronaut James Lovell was assigned to lead the investigation into the cause of the accident. Examination of the aircraft revealed that Freeman's canopy was hit by the goose, with flying shards of canopy appearing to have entered the jet engine causing it to fail. The aircraft was too close to the ground to allow a successful ejection from the cockpit.

A native of Haverford, Pennsylvania, Freeman attended the University of Delaware at Newark for one year, then entered the U. S. Naval Academy and graduated in 1953. In 1960, he received a master's in aeronautical engineering from the University of Michigan.

Freeman graduated from the Air Force's Experimental Test Pilot and Aerospace Research Pilot courses. His last Air Force assignment was as a flight test aeronautical engineer and experimental flight test instructor at the Aerospace Research Pilot School at Edwards Air Force Base, California.

A captain in the U. S. Air Force, Freeman was one of the third class of NASA astronauts. Selected in October 1963, this group served in key roles in the Gemini and Apollo Programs. He was a formidable test pilot with more than 3,300 hours flying time, including more than 2,400 hours in jet aircraft.

Freeman was buried at Arlington National Cemetery and is memorialized on the Space Mirror Memorial at the visitor complex.



Theodore Freeman was selected as part of the third group of NASA astronauts in October 1963. Photo credit: NASA

THEODORE C. FREEMAN  
1930 -1964

# AMERICAN VETERAN MELVIN MORRIS

Medal of Honor recipient Melvin Morris spoke to veterans and guests during a Veterans Day luncheon hosted by the KSC Veterans Employee Resource Group on Nov. 19 at the Space Station Processing Facility (bottom left). Morris shared the importance of each team member and how every mission depends on each and every one.





National Aeronautics and Space Administration

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SP-2014-11-357-KSC

SPACEPORT MAGAZINE