

Aug. 2014 Vol. 1 No. 5

National Aeronautics and  
Space Administration



Kennedy Space Center's

# SPACEPORT

## MAGAZINE

HISTORIC FACILITY  
RENAMED FOR  
NEIL ARMSTRONG

LAUNCH PAD  
SHORELINE  
GETS FACELIFT

INTERACTIVE EXHIBIT  
BRINGS ASTEROIDS,  
METEORS TO LIFE

# KENNEDY SPACE CENTER'S SPACEPORT MAGAZINE

## CONTENTS

- 4**.....NASA renames historic facility after Neil Armstrong
- 11**.....Former astronauts recall first moon landing
- 16**.....Vehicle Assembly Building modifications underway for Space Launch System
- 22**.....Restoration of protective shoreline completed
- 29**.....University students developing robotic gardening technology
- 34**.....Exhibit brings asteroids and meteors to life



**FRONT COVER:**  
Back inside the lunar module following the historic first moonwalk, Apollo 11 mission commander Neil Armstrong is all smiles. On July 21, 2014, the facility where he and his crewmates suited up for the first lunar landing was renamed the Neil Armstrong Operations and Checkout Building.  
Photo Credit: NASA/Buzz Aldrin



**BACK COVER:**  
The first humans who will step foot on Mars are walking the Earth today. The Apollo missions blazed a path for human exploration to the moon and today we are extending that path to near-Earth asteroids, Mars and beyond. The Path to Mars begins with research on Earth and extends beyond its boundaries aboard the orbiting laboratory of the International Space Station.

### NASA'S LAUNCH SCHEDULE

**Date: No Earlier Than September 2014**  
**Mission:** SpaceX-4 Commercial Resupply Services flight with ISS-RapidScat  
**Description:** Launching from Cape Canaveral Air Force Station, Florida, SpaceX-4 will deliver cargo and crew supplies to the International Space Station. It also will carry the ISS-RapidScat instrument, a replacement for NASA's QuikScat Earth satellite to monitor ocean winds for climate research, weather predictions, and hurricane monitoring.

**Date: Sep. 25, 2014**  
**Mission:** Expedition 41 launch to the International Space Station  
**Description:** Soyuz 40 with Barry Wilmore, Elena Serova and Alexander Samokutyaev will launch on Soyuz 40 from the Baikonur Cosmodrome in Kazakhstan.

**Date: No Earlier Than Oct. 14, 2014**  
**Mission:** Orbital-3 Commercial Resupply Services flight  
**Description:** Launching on an Antares rocket from Wallops Flight Facility, Virginia, Orbital-3 will deliver cargo and crew supplies to the International Space Station.

# I am KENNEDY SPACE CENTER

National Aeronautics and  
Space Administration



# Amanda Griffin



Amanda Griffin works in Education and External Relations. Most of what she does is centered on engaging and inspiring others with NASA's story and mission. Her favorite part of work is seeing a spark for space ignited in a child. She enjoys her work with students because many at-risk kids don't know much about the nation's space program, and she gets to help illuminate the great work NASA does and encourage them to one day be a part of it. To Amanda, working at NASA is the ultimate conversation starter and allows her the opportunity to talk about what amazing things are on the horizon for the world's continued leader in space.

### THE SPACEPORT MAGAZINE TEAM

#### Editorial

Managing Editor ..... Chris Hummel  
Editor..... Frank Ochoa-Gonzales  
Assistant Editor..... Linda Herridge  
Copy Editor ..... Kay Grinter

#### Writers Group

Bob Granath      Anna Heiney  
Kay Grinter      Linda Herridge  
Frank Ochoa-Gonzales      Steven Siceloff

#### Graphics Group

Richard Beard      Matthew Young  
Lynda Brammer      Amy Lombardo  
Greg Lee

# American Icon

## NASA renames historic facility for Neil Armstrong

BY BOB GRANATH

When visitors come to Kennedy Space Center, iconic facilities such as the mammoth Vehicle Assembly Building (VAB) and launch pads leave lasting impressions. Another facility that has had a long-standing impact on America's human spaceflight programs recently was renamed in honor of Neil Armstrong. He has been hailed as one of the greatest heroes of the nation's efforts to explore.

Originally constructed as the Manned Spacecraft Operations Building, the facility was renamed the Operations and Checkout (O&C) Building prior to the start of the Space Shuttle Program. As Kennedy transitions from a historically government-only launch facility to an affordable, sustainable, multi-user spaceport for both government and commercial

customers, the O&C was dedicated as the Neil Armstrong Operations and Checkout Building in ceremonies July 21.

NASA Administrator Charles Bolden, Kennedy's Director Bob Cabana, Apollo 11 crewmates Mike Collins and Buzz Aldrin, along with astronaut Jim Lovell and members of the Armstrong family, were on hand for the event.

The ceremony coincided with the anniversary of Armstrong and fellow Apollo 11 astronaut Aldrin completing the first exploration of the lunar surface and subsequent liftoff from the moon.



At Kennedy Space Center on July 21, NASA Administrator Charles Bolden addresses the audience at a ceremony renaming the Operations and Checkout Building for Apollo 11 astronaut Neil Armstrong, the first person to set foot on the moon. Also participating in the event are, from the left, Center Director Bob Cabana, Armstrong's sons Rick and Mark, Apollo astronauts Jim Lovell, Buzz Aldrin and Mike Collins. Photo credit: NASA/Kim Shiflett

This aerial view taken on July 29, 1963, shows construction of the Manned Spacecraft Operations Building at NASA's Merritt Island Launch Annex (MILA). Later that year, MILA would be renamed the John F. Kennedy Space Center. Launch pad towers at Cape Canaveral Air Force Station are visible on the horizon. Photo Credit: NASA



"It's altogether fitting that today we rename this facility the Neil Armstrong Operations and Checkout Building," said Bolden, a former shuttle astronaut. "He, along with his crewmates, Buzz Aldrin and Michael Collins, are a bridge from NASA's historic journey to the moon 45 years ago to our path to Mars today."

Also a former shuttle commander, Cabana echoed Bolden's comments.

"I can't think of anybody better whose name could be on the O&C than Neil Armstrong," he said. "Neil was a superb engineering test pilot and one of the finest gentlemen I've ever known."

Lovell, who flew on Gemini 7 and 12, as well as Apollo 8 and 13, served as backup commander for the first lunar landing mission.

"Neil Armstrong was a close friend who represented the best in America," he said.

Aldrin expressed appreciation for being selected to fly beside Armstrong on the first lunar landing mission.

"When Neil was questioned if he wanted me to go along with him (as lunar module pilot on Apollo 11), he said, 'yes,'" Aldrin said. "I will be ever grateful."

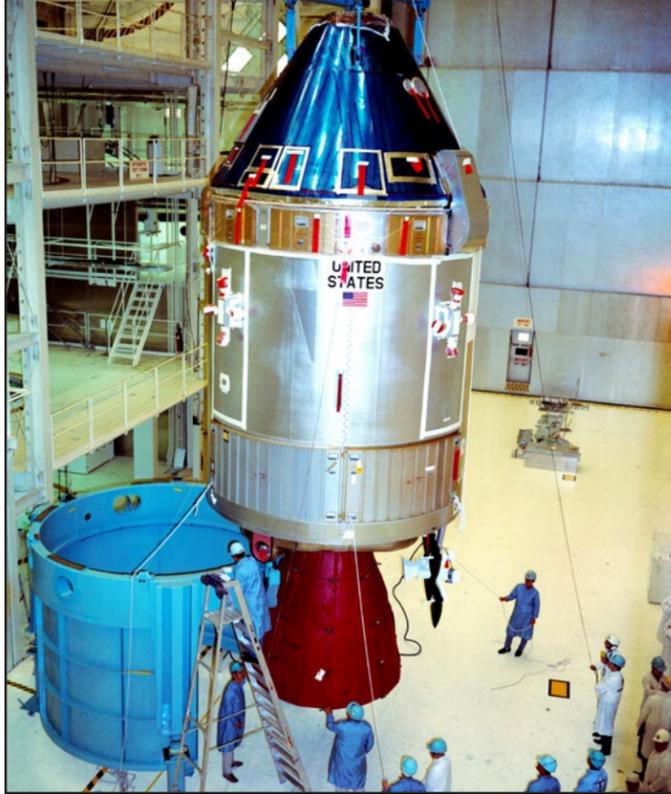
As command module pilot on Apollo 11,

Collins remained in orbit around the moon while his crewmates landed. He recalled Armstrong's first words as he stepped on the lunar surface, "That's one small step for (a) man, one giant leap for mankind."

"We all remember Neil's 'one small step,'" Collins said. "That powerful, powerful combination of curiosity and intelligence propelled him to the top of his profession over and over again. He took it one step further and that eventually brought him to the last rung on the ladder of the Apollo 11 LM (lunar module)."

After serving as a naval aviator, Armstrong went on to fly the X-15 rocket-powered aircraft seven times between 1960 and 1962. He served as command pilot of Gemini VIII in 1966 and became the first person to walk on the moon as commander of Apollo 11 in 1969. He died Aug. 25, 2012, at the age of 82.

On Jan. 21, 2000, the O&C Building was added to the U.S. National Register of Historic Places. Today, the building's high bay is the site where the agency's Orion spacecraft is being assembled. Orion is designed to take humans farther than they've ever gone before, serving as the exploration vehicle that will carry astronauts to deep space and sustain the crew during travel



The Apollo 11 command/service module is being moved from a work stand during spacecraft processing in the high bay of the Manned Spacecraft Operations Building on April 11, 1969. Photo credit: NASA



A crane is used to move the lunar module for the Apollo 12 mission on June 23, 1969. In November that year, Apollo 12 would complete the second mission to land humans on the moon. Photo credit: NASA



Apollo 11 commander Neil Armstrong leads command module pilot Mike Collins and lunar module pilot Buzz Aldrin from the Manned Spacecraft Operations Building to the transfer van for the eight mile trip to Launch Pad 39A. The July 16, 1969 liftoff of Apollo 11 began the first lunar landing mission. Photo credit: NASA

to destinations such as an asteroid or Mars. Completed in 1964, the O&C was the first building finished at Kennedy and has housed astronaut crew quarters since the mid-1960s when Gemini astronauts stayed there prior to launch. The building is a five-story 602,000-square-foot structure and, as such, is

the largest facility in the Industrial Area of the Florida spaceport. In addition to the astronaut crew quarters, it houses offices, payload and spacecraft checkout and assembly areas, as well as science laboratories.

Located on the third floor, the crew quarters includes meeting rooms and bedrooms. Specialized facilities include the room in which Apollo astronauts, such as Armstrong, and shuttle crews donned and tested their pressure suits prior to the trip to the launch pad.

During the 1960s and early 1970s, some of the Gemini capsules and all Apollo lunar modules and command modules were processed and tested in the high bay prior to being stacked atop their rockets. The high bay area is 175 feet long, 104 feet high and the adjacent low bay is 475 feet long and 70 feet high.

In 1965, a pair of altitude chambers was installed in the high bay for testing the environmental and life support systems of both the Apollo command/service modules and lunar modules at simulated altitudes of up to



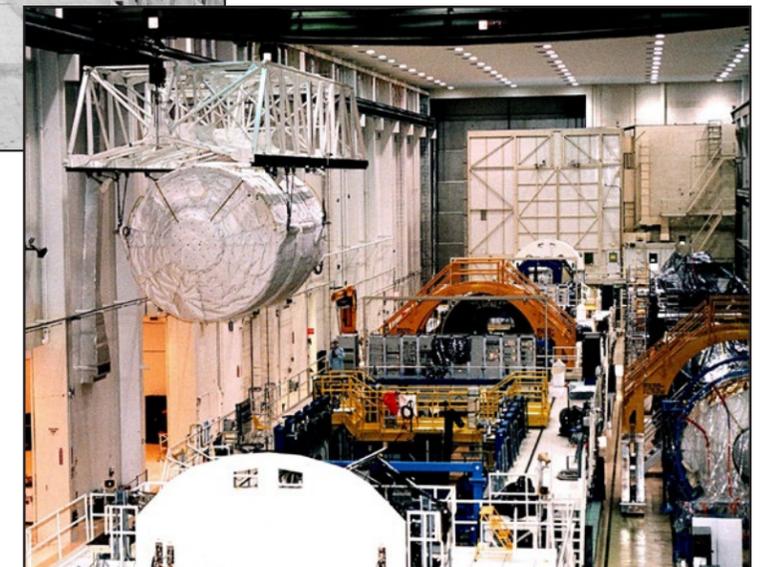
Left: At the Kennedy Space Center, structural work is ongoing inside the high bay of the Operations and Checkout Building. The modifications are taking place to reconfigure the facility from Apollo Program activities and prepare to support payload processing for space shuttle missions. Photo Credit: NASA



The STS-95 crew walks out from the crew quarters in the Operations and Checkout Building for their trip to Launch Pad 39B on Oct. 29, 1998. Leading the group are National Space Development Agency of Japan astronaut Chiaki Mukai, left, and mission commander Curt Brown. Payload specialist John Glenn is directly behind Brown, while pilot Steve Lindsey is to Glenn's right. Behind Glenn is European Space Agency astronaut Pedro Duque of Spain and mission specialists Scott Parazynski and Stephen Robinson. Photo credit: NASA

250,000 feet. The chambers were used by the crews of all Apollo missions through Skylab in 1973 and 1974, as well as the Apollo-Soyuz Test Project in July 1975.

The high bay was modified during the



Below: On Jan. 30, 1997, the Spacelab module for the Microgravity Science Laboratory-1 mission is moved to be placed in a payload canister in the Operations and Checkout Building. Once in the canister, the Spacelab module will be transported to Bay 1 of the Orbiter Processing Facility where it will be installed into a space shuttle payload bay for the STS-83 mission. Photo credit: NASA

late 1970s to support cargo integration tests performed to verify compatibility with space shuttle systems. In the 1980s and 1990s, Spacelab modules were processed and tested for flights in space shuttle cargo bays.

Spacelab was a reusable laboratory on shuttle missions, allowing astronauts to perform extensive experiments in microgravity.

During the 1990s the west altitude chamber was reactivated with new pumps, controls and handling systems to support International Space Station (ISS) checkouts. The space station's pressurized modules, including the ISS Airlock and U.S. Laboratory were vacuum-tested in the chambers. Processing activities also included hardware staging, payload integration and verification.

The high bay underwent another extensive, two-year renovation starting in 2007 to outfit the



In the Operations and Checkout Building on June 30, 2000, the U.S. laboratory module, a component of the International Space Station, is lifted off the floor to be raised to a vertical position. The lab, named Destiny, underwent testing in the altitude chamber in the O&C. Photo credit: NASA

facility for the final assembly of NASA's Orion spacecraft. Space Florida, Lockheed Martin and NASA provided funds to clear the facility of about 50 tons of steel stands, structures and equipment. The refurbishment involved replacing the entire facility support infrastructure and installing new overhead cranes to support manufacturing and assembly work.



Inside the Operations and Checkout Building high bay May 30, 2014, Lockheed Martin technicians and engineers attach the heat shield to the Orion crew module for Exploration Flight Test-1. The mission will provide engineers with data about the heat shield's ability to protect Orion and its crews from the 4,000-degree heat of re-entry and an ocean splashdown following the spacecraft's 20,000-mph re-entry from space. Photo credit: NASA/Daniel Casper

With the renovations complete, unique tooling stations and fixtures were installed. The first Orion scheduled to go into space arrived in the O&C high bay in June 2012 in the form of a primary structure pressure vessel. It now is being assembled into a flight-ready spacecraft for the uncrewed Exploration Flight Test-1 atop a Delta IV rocket, slated for December 2014.

In the future, Orion will launch on NASA's new heavy-lift rocket, the Space Launch System. More powerful than any rocket ever built, SLS will be capable of sending humans to deep-space destinations.

During the ceremony to rename the O&C, Armstrong's sons Rick and Mark addressed those gathered for the program.

"On behalf of the Armstrong family, I'd like to thank you for this tremendous honor," Mark Armstrong said. "This Orion vehicle behind us is truly impressive. It is our hope that the new name that graces this facility will inspire those who work here for many, many years to come."

During a visit in April 2012, former NASA astronaut Neil Armstrong sits in the commander's seat of space shuttle Atlantis. The spacecraft was being prepared for display at the Kennedy Space Center Visitor Complex. Photo credit: NASA/Dimitri Gerondidakis

## ***The Neil Armstrong Operations and Checkout Building***

# ***Did You Know?***

- The facility opened as the Manned Spacecraft Operations Building in 1964, 50 years ago.
- Astronaut crew quarters includes meeting rooms, bedrooms and specialized facilities in which astronauts don and test their pressure suits prior to the trip to the launch pad.
- The facility houses offices and science laboratories, as well as payload and spacecraft checkout and assembly areas.
- The building is five stories high.
- With 602,000 square feet, it is the largest facility in the Industrial Area of Kennedy Space Center.
- The high bay area is 175 feet long and 104 feet high.
- The low bay is 475 feet long and 70 feet high.

### ***As the Manned Spacecraft Operations Building***

- During the mid-1960s, Gemini spacecraft were processed and checked out.
- During the mid-1960s through 1975, Apollo command/service modules and lunar modules were processed and tested.

### ***As the Operations and Checkout (O&C) Building***

- During the 30-year Space Shuttle Program (1981-2011), cargo integration tests were performed.
- Spacelab modules were processed and tested for flights in space shuttle cargo bays.
- International Space Station pressurized modules such as the Quest Airlock and Destiny U.S. Laboratory were checked out in the high bay's altitude chamber.
- On Jan. 21, 2000, the O&C Building was added to the U.S. National Register of Historic Places.
- Following a two-year renovation starting in 2007, the high bay became the site for assembly of NASA's Orion spacecraft.

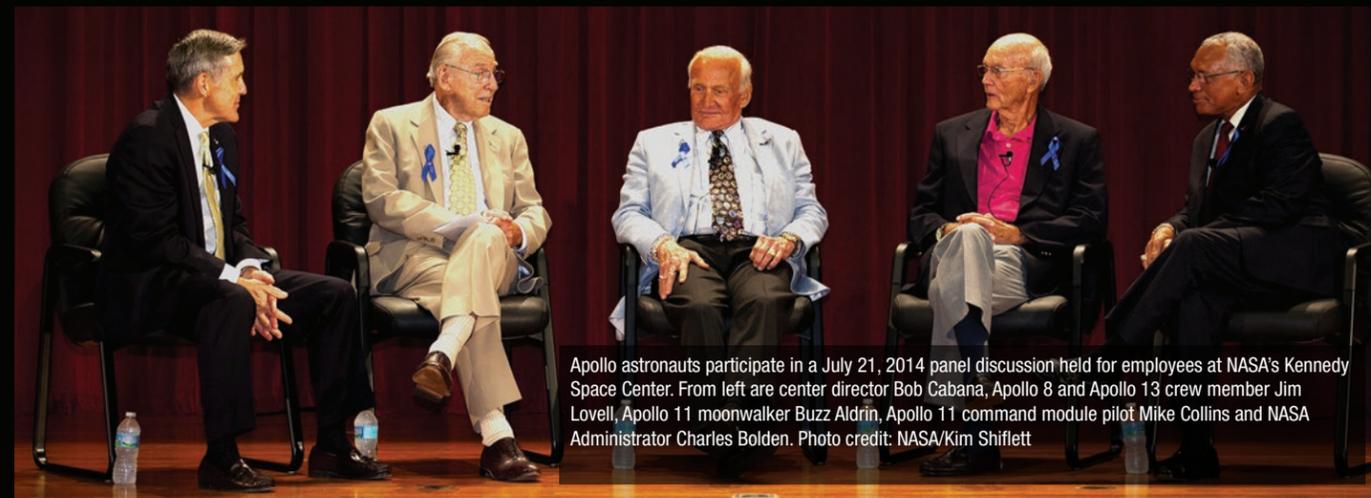
***On July 21, 2014, the facility was renamed the Neil Armstrong Operations and Checkout Building.***

Apollo 11 lifts off from the Kennedy Space Center on July 16, 1969. Photo credit: NASA



# WE DID IT!

## Former Astronauts Recall Historic First Moon Landing



Apollo astronauts participate in a July 21, 2014 panel discussion held for employees at NASA's Kennedy Space Center. From left are center director Bob Cabana, Apollo 8 and Apollo 13 crew member Jim Lovell, Apollo 11 moonwalker Buzz Aldrin, Apollo 11 command module pilot Mike Collins and NASA Administrator Charles Bolden. Photo credit: NASA/Kim Shiflett

*“Tranquility Base here, the Eagle has landed!”*

BY BOB GRANATH

With these words, American astronaut Neil Armstrong announced that he and Buzz Aldrin had become the first persons to travel to and land on another celestial



world -- 45 years ago.

One of humankind's greatest achievements, the Apollo 11 mission began with the July 16, 1969, liftoff of a Saturn V rocket from Kennedy Space Center and set the stage for the historic lunar

landing.

Following a July 21 ceremony to rename the Florida spaceport's Operations and Checkout Building, or O&C, in honor of Armstrong, space center employees had an opportunity to hear from Apollo 11 crew members Mike Collins and Aldrin, along with NASA Administrator Charles Bolden and Kennedy Director Bob Cabana. They also were joined by former Apollo astronaut Jim Lovell. The O&C is where Apollo spacecraft were prepared for flight and where the agency's Orion capsule is being

“When it was my turn to back out, I remember the checklist said to reach back and carefully close the hatch, being careful not to lock it,” said Buzz Aldrin, Apollo 11's lunar module pilot. Photo credit: NASA/Neil Armstrong



“I was in the control center watching everything,” Jim Lovell said. Astronauts are among those monitoring consoles in the tension-filled final moments as the Apollo 11 lunar module descended to the moon on July 20, 1969. Charlie Duke, foreground, served as a spacecraft communicator, or CAPCOM. Next to him are backup crew members Lovell and Fred Haise. Photo credit: NASA



As Mike Collins remains in lunar orbit, some thought he might be the most lonesome person in the universe. "Actually, I was so glad to get behind the moon so Mission Control would shut up. Then I had some peace and quiet," Collins joked. Photo credit: NASA

Robert Kennedy) and the riots," he said. "Apollo 8 was the high point in my space career. NASA put a spacecraft around the moon on Christmas Eve, and it changed the whole attitude of the country."

The Apollo 11 landing also was an event that united the population of Earth.

processed for future missions beyond the moon.

As his fellow Apollo 11 crew members explored the lunar surface, Collins orbited the moon in the command module.

The July 20, 1969, lunar landing was the culmination of a goal set eight years earlier by President John F. Kennedy during the peak of the Cold War. It was a time of technological advances as well as global social and political upheaval.

Lovell served on the first crew to leave Earth orbit and travel to orbit the moon in December 1968. He noted that in spite of problems in the world, Apollo brought people around the world together to celebrate the achievement.

"You have to remember what the United States was like in 1968 with the Vietnam War, the murders (of Rev. Martin Luther King Jr. and Sen.

Armstrong climbed down the ladder of the lunar module the crew had named Eagle. At 10:56 p.m. EDT, on the day of the landing, he pressed the sole of his left boot to the primeval soil of the lunar surface.

"That's one small step for (a) man, one giant leap for mankind," he said as an estimated 530 million people around the world watched on television. In the United States, 93 percent of the population's TVs were tuned to one of the three major networks covering the occasion.

Commenting on the global impact of the first lunar landing, Collins recalled that he, Armstrong and Aldrin made an extensive trip around the world following the mission.

The reactions of some were unexpected.

"The thing that really surprised me was that everywhere we went people didn't say, 'Well you Americans finally did it,'" he said. "They said, 'We did it.' All of us together, we did it. It was a wonderful sensation."

Lovell agreed, explaining his reaction after Apollo 11 returned to Earth.

"We did it," he said. "We actually put people on the surface of the moon."



During a training session at Kennedy Space Center on Jan. 28, 1970, astronaut Jim Lovell suits up for an extravehicular activity simulation for the Apollo 13 mission. Photo credit: NASA

Cabana asked Aldrin, Collins and Lovell to recall memories of the event.

Aldrin noted that as he prepared to exit the lunar module, it was important to remember even small details.

"I watched out the window to see Neil go down the ladder,"

he said. "When it was my turn to back out, I remember the checklist said to reach back carefully and close the hatch, being careful not to lock it."

As Aldrin said that on the moon, Armstrong laughed, "Particularly good thought!"

Aldrin recalled that Collins tried to find the Tranquility Base landing site with the sextant, but couldn't.

"I didn't know where you were," said Collins, who performed two spacewalks during Gemini 10 in July 1966. "The sextant was like looking down the barrel of a rifle. It had a really narrow field of view."

Cabana asked Collins what it was like in the command module performing experiments and photographing the lunar surface.

"I was the most lonesome person in the whole universe -- at least according to the newspapers," Collins said. "Actually, I was so glad to get

behind the moon so Mission Control would shut up. Then I had some peace and quiet."

His comment immediately resulted in laughter from the audience.

Aldrin, who flew with Lovell on Gemini 12 in November 1966, explained that some things worked differently in the lunar environment.

"The TV camera had a wire going back to the lunar module," he said, "so they tested it on Earth, and the wire would lie flat on the ground. In the moon's one sixth G . . . nah! . . . just waiting for some clumsy guy to not see it."

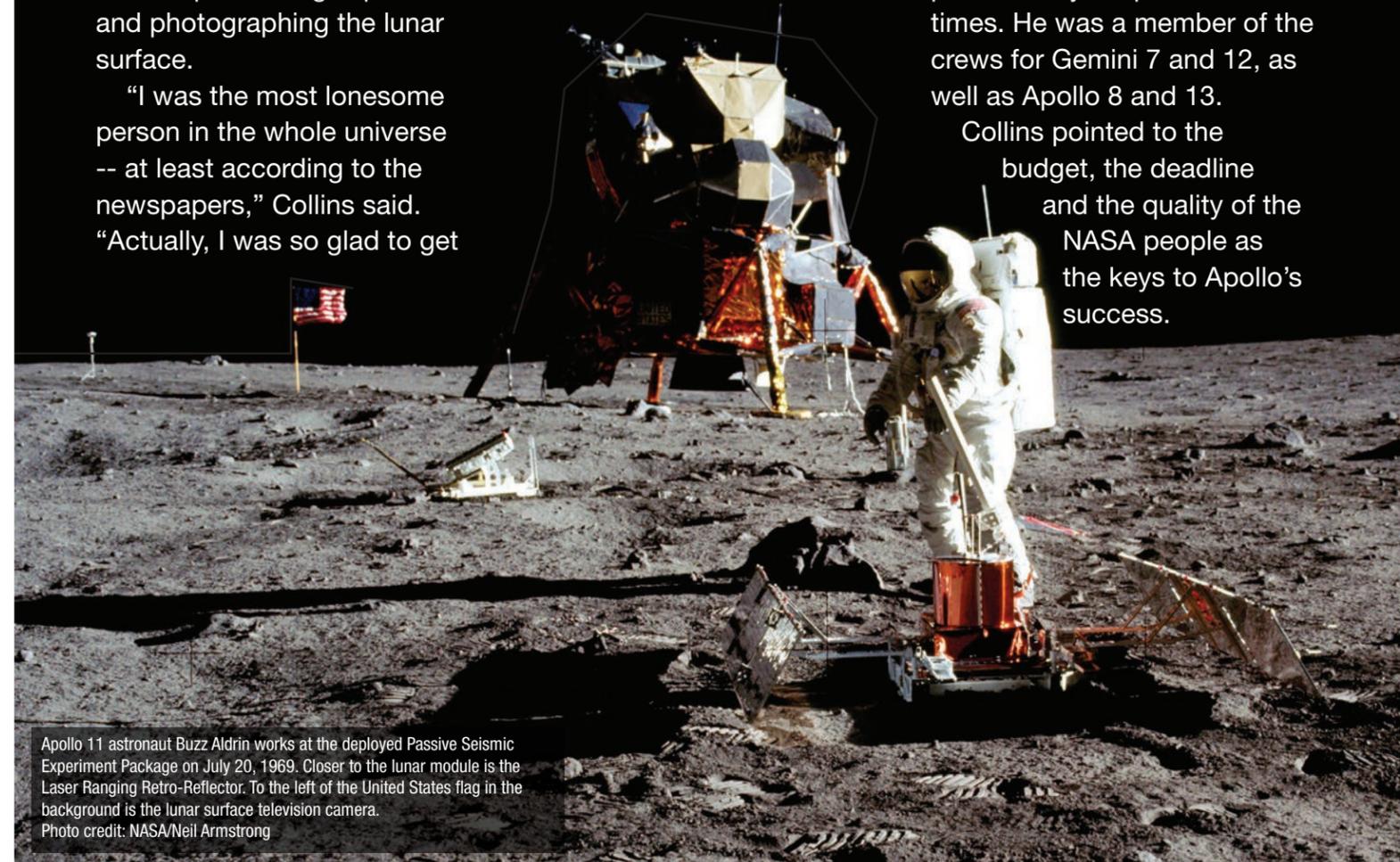
When Cabana asked each to give his impression of the

legacy of Apollo, Aldrin stated that it was about meeting a challenge even though it was something many believed could not be done. He recalled a line from Kennedy's speech at Rice University in Houston on Sept. 12, 1962.

"We choose to go to the moon in this decade and do the other things," Kennedy said, "not because they are easy, but because they are hard."

"The legacy of Apollo is, if you set your mind to do something, get everybody together and everybody agrees we should accomplish it, and then we go ahead, it became something we all could be proud of," said Lovell, the first person to fly in space four times. He was a member of the crews for Gemini 7 and 12, as well as Apollo 8 and 13.

Collins pointed to the budget, the deadline and the quality of the NASA people as the keys to Apollo's success.



Apollo 11 astronaut Buzz Aldrin works at the deployed Passive Seismic Experiment Package on July 20, 1969. Closer to the lunar module is the Laser Ranging Retro-Reflector. To the left of the United States flag in the background is the lunar surface television camera. Photo credit: NASA/Neil Armstrong

“We had three important things going for us, two of which we don’t have today,” he said. “The first one was, I wouldn’t say money was no object, but we were getting slightly over three percent of the federal budget. The second one was a deadline -- by the end of the decade. You could motivate people... saying, ‘We gotta do this by the end of the decade.’ It was a very powerful tool.

“The third thing, we still have,” Collins said. “We had a lot of smart people, young people, dedicated people who got to work early, stayed at work late. You didn’t have to tell them they were part of a team, they knew they were part of a team.”

While in the Neil Armstrong Operations and Checkout Building, Lovell, Aldrin and Collins were given an opportunity to get an up-close look at NASA’s new Orion spacecraft.

“All the stuff you learned from Apollo is now being applied to Orion,” Lovell said.

Collins observed, “Orion is (shaped) geometrically like the Apollo command module. It looks to me like

Orion is well on its way to becoming as good or better flying machine than the Apollo command module.”

When Bolden asked for advice as we move forward with Orion, Collins encouraged the NASA workforce to stay focused.

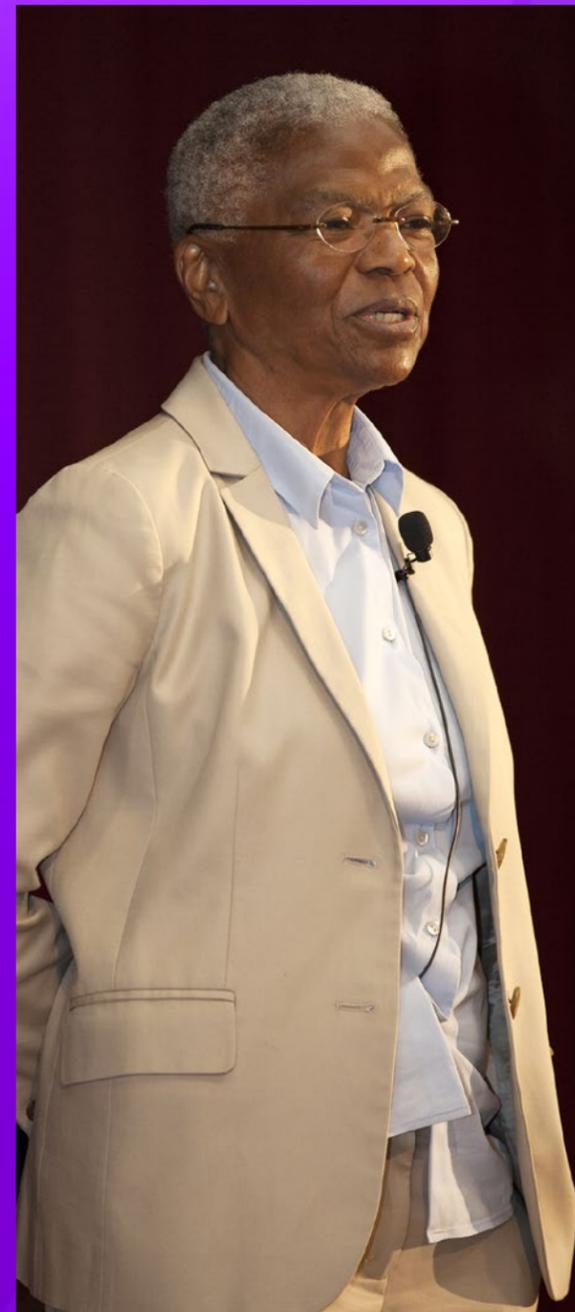
“The path you are on is a good path, perhaps the best path,” Collins said. “From everything I’ve seen around here today, NASA’s future is in very capable hands and you’ll be as successful as Apollo.”



As astronaut Buzz Aldrin explores the moon’s Sea of Tranquility, Neil Armstrong and the lunar module, Eagle, are reflected in his helmet visor. Photo credit: NASA/Neil Armstrong

# We’ve come a long way

## We’ve come a long way



### July marked the 50th anniversary of the Civil Rights Act of 1964

To observe the anniversary, the Office of Diversity and Equal Opportunity hosted Dr. Mary Frances Berry, a civil rights pioneer, to remind some employees of the obstacle-laden path leading to where we are today and to educate others, perhaps too young to be aware of the difficult journey required. The event was held July 8 in the Kennedy Training Auditorium.

“I think it’s really important that we take time to commemorate the 50th anniversary of the Civil Rights Act,” Center Director Bob Cabana said during his opening remarks. “You know it all started with President Kennedy in 1962, and after his assassination, it was President Johnson that actually brought it into law.”

Cabana challenged the audience with some thought-provoking questions: “Why did we have to have a law for what should just be common courtesy?”

For the complete story, go to <http://www.nasa.gov/content/weve-come-a-long-way/>

a look online

more online

# MASSIVE UPGRADE

## Vehicle Assembly Building modifications underway for Space Launch System

BY LINDA HERRIDGE

History was made in the 525-foot-tall Vehicle Assembly Building (VAB) at Kennedy Space Center. It was inside the VAB that NASA's Apollo/Saturn V rockets and space shuttles were prepared for their rollout to Launch Pads 39A and B to begin their missions.

Today, the Ground Systems Development and Operations Program and support contractors at Kennedy are busy upgrading the massive building for the next chapter in human exploration. The Space Launch System (SLS), NASA's new heavy-lift rocket, will be the largest launch vehicle ever built and more powerful than the Saturn V rocket. The SLS will send astronauts aboard the Orion spacecraft to explore deep space destinations including an asteroid and eventually Mars.

"We have a lot of work to complete, and now is the time to refurbish and upgrade the VAB before we begin processing launch vehicles," said Steve Starr, a senior project manager with Vencore on the Engineering Services Contract.

In the five decades since the VAB was built, safety codes have changed, technology has advanced dramatically and the facility's steel structure and machinery have aged.

In 2013, all of the platforms in High Bay 3 were removed to make way for a new platform system that will be used to access the SLS and Orion spacecraft that will launch atop the rocket. The high bay also will accommodate the 355-foot-tall mobile launcher that will carry the rocket and



An aerial view of the Vehicle Assembly Building (VAB) in the Launch Complex 39 area at Kennedy Space Center. The Launch Control Center is in front of the VAB. Photo credit: NASA/Kim Shiflett

## The Vehicle Assembly Building at a glance

- Height: 525 feet
- Width: 518 feet
- Constructed of 65,000 cubic yards of concrete.
- Frame constructed of 98,950 tons of steel.
- Support base consists of 4,225 steel pilings driven 164 feet into bedrock.
- 4 high bay doors 456 feet high that take approximately 45 minutes to open or close.
- 5 overhead cranes, including 2 that can hold 325 tons.

For more information on the Ground Systems Development and Operations Program, go to <http://go.nasa.gov/groundsystems>

The 175-ton crane is in view high above in this view looking down the transfer aisle inside the Vehicle Assembly Building at Kennedy Space Center. Photo credit: NASA/Dimitri Gerondidakis



A view looking down from one of the higher levels in the Vehicle Assembly Building reveals High Bay 3 at Kennedy Space Center. Photo credit: NASA/Dimitri Gerondidakis



spacecraft atop the crawler-transporter to the launch pad.

In the planning and design stage, 10 levels of new platforms will surround the rocket and spacecraft and provide access for testing and processing. The platforms have been designed to move in and out, and translate up and down as needed. This sophisticated platform system is being designed so that it can accommodate other launch vehicles and configurations with minimal adjustments.

“The VAB project team, along with the entire GSDO Program office, continues to be on fire with excitement as we take a concept of providing a reconfigurable high bay, and initiate the construction effort,” said Jose Lopez, VAB senior project manager. “This project is something that NASA and the entire nation can be proud of.”

Lopez said when the project is complete, the VAB will be able to adapt to evolving launch vehicle configurations, without major construction efforts, something that has never

been done before.

Prototype platforms have been tested at the Launch Equipment Test Facility and studies were completed to understand the kinds of mechanisms needed to move platforms up and down.

Computer-aided design visualization tools are being utilized to help designers model every aspect of this new system. Power cables, communication lines and high pressure fluid

lines at each level will have the ability to move up and down freely along with the platforms. Elevator landings on the structure also need to be relocatable.

Workers are upgrading the low-voltage power sources in phases, beginning with High Bay 3 first. More than 150 miles of abandoned copper and lead-shielded cabling, dating back to the Apollo and Space Shuttle Programs, have been removed and are being replaced with fast and more efficient fiber optic cables. Apollo-era water, sewer and drainage piping also is scheduled for future replacement. Installation of a new fire protection system is underway.

All four of the large vertical-lift doors have been repaired and upgraded. In the F tower, a second elevator will be added. Old or unnecessary ground support equipment has been removed, including large beams in High Bay 1, where the Apollo/Saturn V was stacked, and a 125-ton bridge crane in High Bay 4 that has not been used in 20 years.

The enormous structure is made of concrete and steel, which has naturally aged over the years. Studies and field investigations are underway to quantify corrosion to steel and ground support equipment, and identify and repair spalling in the concrete.

“When we consider the monumental effort that went into designing and constructing the VAB, all done in the early 1960s without the technology we have today, I am proud to be a part of renovating and upgrading the facility to support the next generation of human spaceflight,” Starr said.

Starr hopes that the nation’s human spaceflight program will benefit from the work being accomplished today, and that future generations will be able to build on the foresight of the original design and the improvements currently underway.



Construction workers hang protective drop cloths near High Bay 3 inside the Vehicle Assembly Building at Kennedy Space Center. Photo credit: NASA/Dimitri Gerondidakis

Steel structures surround High Bay 3 inside the massive Vehicle Assembly Building at Kennedy Space Center. In view, high above, is the 175-ton crane. Banners note the heights of the Saturn V, Space Launch System (SLS) and shuttle on the steel structure. Modifications are underway in the VAB to prepare High Bay 3 for a new platform system. Photo credit: NASA/Dimitri Gerondidakis

# Beach RESTORE

Restoration of protective  
shoreline completed  
near launch pads

BY BOB GRANATH



In this time lapse photograph taken Jan. 23, 2014, an Atlas V rocket lifts off from Cape Canaveral Air Force Station's Space Launch Complex 41 boosting NASA's Tracking and Data Relay Satellite to Earth orbit. The light of the launch illuminates the sand dune restoration site at NASA's Kennedy Space Center. Photo credit: NASA/Tony Gray

Majestic sand dunes along a pristine shoreline can make for a picturesque landscape. They also serve a crucial role in the natural environment.

A six-month project to repair protective sand dunes along the shoreline of Kennedy Space Center recently was completed. The effort was celebrated with a ceremony at the site of the restoration effort.

Frequent pounding from storms, especially Hurricane Sandy in October 2012, along with other weather systems, such as higher than usual tides, destroyed the sand dunes protecting important infrastructure at the spaceport.

With the additional effects of climate change showing up from Miami to Alaska, two University of Florida (UF) geologists are focusing their attention on the shores of the center.

Nancy Bray, Center Operations director for Kennedy, said NASA is taking the situation seriously and has plans for dealing with it. A similar plan has been prepared for NASA's Wallops Island Flight Facility in Virginia, though Wallops has not yet seen the effects that have shown up at Kennedy.

"We do consider sea-level rise and climate change to be urgent," she said. "Without that

secondary dune line, we could have saltwater intrusion at the launch pad."

According to Don Dankert, a biological scientist in the NASA Environmental Management Branch of Center Operations, the work completed a reconstruction effort that began in October 2013.

"We built a 1.2-mile dune," he said. "It's all donated sand from our (U.S. Air Force) friends over on Cape Canaveral Air Force Station. They provided us with 90,000 cubic yards of beach-quality sand."

Glenn Semmel, chief of the Environmental Management Branch of Center Operations, pointed out that vegetation was planted along the new dune to prevent erosion.

"All totaled, 180,000 plants were placed along the restored stretch of beach," he said. "As they take root and grow, the vines and shrubs should hold the sand in place."

The May 2 ceremony included Burton Summerfield, a senior advisor for Institutional Management in the office of the Kennedy associate director, and Becky Bolt, a wildlife ecologist with InoMedic Health Applications Inc. (IHA), joining Dankert in planting the final palmetto palm at the base of the mound.

Assistant professor Peter Adams of the UF Geological

Sciences department and associate professor of geology John Jaeger, along with Kennedy officials, began developing a strategy for restoration of the space center shoreline in 2009.

"It started about five years ago with the formation of the Dune Vulnerability Team to assess the condition of our shoreline and develop a strategy to provide long-term protection," Dankert said. "Our partners with IHA, the University of Florida, the U.S. Army Corps of Engineers and the U.S. Geological Survey, helped us develop a plan for preserving our diminishing shoreline."

He added that this is just one small part of an overall project to reconstruct the dunes along the Kennedy shoreline.

Over the years, tropical weather has continually battered the shoreline. Some systems pass by, but there have been a few direct hits. Even though it did not make landfall, one of the most destructive storms ever to hit the United States was Hurricane Sandy, which pounded the beaches of Brevard County in Florida, including those at Kennedy in 2012. The storm continued up the coastline, damaging the Southeastern and Mid-Atlantic states before delivering a devastating

blow to the Northeast.

"It's a constant battle to restore the dunes that hold off the weather-induced erosion," Dankert said. "The new dune is going to provide protection along our most critically eroded stretch of shoreline."

The new stretch of reconstructed sand dunes is near two key spaceport facilities -- Launch Pads 39A and 39B. NASA officials recently announced a 20-year property agreement with SpaceX for operation of Pad 39A for the Falcon Heavy rocket. At nearby Pad 39B, work is underway to support the agency's heavy-lift Space Launch System rocket and Orion spacecraft.

Looking further into the future, the agency is taking an approach it calls "managed retreat." That means if sea-level rise becomes insurmountable, Bray said, NASA eventually may have to move roads, utilities and perhaps even launch pads -- a costly and complex possibility.

In addition to rebuilding the dunes, the team's efforts included planting native vegetation on newly created dunes to provide soil stabilization and to benefit native wildlife.

"We planted grasses, sunflowers, vines, sea



Kennedy Space Center's Don Dankert and Becky Bolt plant the final shrub among 180,000 planted on a restored shoreline near launch pads 39A and 39B. Photo credit: NASA/Dan Casper

grapes and palmettos," Dankert said.

The space center's shoreline also is an important habitat for wildlife, including several endangered species such as the Southeastern beach mouse, indigo snakes and gopher tortoises.

"We've done some great things working with our friends over at the (Merritt Island National Wildlife) Refuge to enhance the beach habitat, especially for our nestling and hatchling sea turtles," he said. "This reconstructed stretch of dune will help shield this section of the beach from light intrusion associated with the pads and the Launch Complex 39 area."

Kennedy's shoreline is an important nesting ground for sea turtles.

Newly hatched turtles can be disoriented by artificial light. During their summer nesting season, turtles emerge from the ocean along the pristine beach within 200 yards of the two launch pads.

By blocking launch pad lighting, Dankert noted that the rebuilt dunes will aid nesting and sea turtle hatchlings as they emerge from their nests and head toward the moonlit horizon of the ocean.

Dankert expressed pride in how well the sand dune project had progressed.

"Our beaches had been slowly eroding for years," he said. "We got it all done pretty quickly, starting in October and we finished a little ahead of schedule."



# Trekking tortoise



A gopher tortoise lumbers down the roadway at Kennedy Space Center in June. Gopher tortoises are dry-land turtles that live in scrub, dry hammock, pine flatwood, coastal grassland and dune habitats. The undeveloped property on Kennedy Space Center is managed by the U.S. Fish and Wildlife Service through the Merritt Island National Wildlife Refuge. Currently, gopher tortoises are protected in some states by federal law under the Endangered Species Act ESA. The refuge provides a habitat for 14 species federally listed as threatened or endangered, including the leatherback, green, Kemp's Ridley, loggerhead and Atlantic hawksbill turtles. Photo credit: NASA/Daniel Casper

For information on the refuge, visit <http://www.fws.gov/merrittisland/index.html>

For more information on the gopher tortoise, visit [http://www.fws.gov/northflorida/GopherTortoise/Gopher\\_Tortoise\\_Fact\\_Sheet.html](http://www.fws.gov/northflorida/GopherTortoise/Gopher_Tortoise_Fact_Sheet.html)

more online

# TURNING SCIENCE FICTION INTO REALITY

University students developing  
robotic gardening technology

BY BOB GRANATH

For more than a half-century, NASA has made the stuff of science fiction into reality. Researchers are continuing that tradition by designing robots to work in a deep-space habitat, tending gardens and growing food for astronaut explorers. It sounds like a concept from Star Wars, but a team of graduate students from the University of Colorado-Boulder now is developing the innovative technology to make it possible.

As astronauts explore beyond Earth, they will need to make their habitat as self-sustaining as possible. This includes growing fruits and vegetables.

“We’re hoping to take advantage of what these and other students are developing and use it in future space missions,” said Tracy Gill, NASA’s technology strategy manager at the Kennedy Space Center. “This program is an opportunity to engage university teams in helping us develop new concepts.”

The University of Colorado team’s entry in the eXploration HABitat (X-Hab) Academic Innovation Challenge is called “Plants Anywhere: Plants Growing in Free Habitat Spaces.” Instead of an area set aside just for vegetation, the approach calls for plants to be distributed in any available space in a deep-space habitat.

The X-Hab challenge is a university-level project designed to engage and retain students in science, technology, engineering and math, or STEM. The competition is intended to link student design projects with senior- and graduate-level curricula that emphasize hands-on design, research, development, and manufacture of functional prototype subsystems that could be used in extraterrestrial habitats and during deep-space exploration missions.

The University of Colorado students demonstrated their X-Hab project at Kennedy’s Space Station Processing Facility on June 23 to a group of employees that included center director Bob Cabana. They are developing a Distributed Remotely Operated Plant Production System, or DROPPS. It is a concept for producing edible plants during long-term missions to destinations such as Mars.

Heather Hava, who is working on a doctorate in aerospace engineering sciences, explains that the goal is to have robots do much of the monotonous



University of Colorado-Boulder graduate student Dane Larsen checks out the forklift on a Remotely Operated Gardening Rover (ROGR) which could tend plants on a deep-space habitat. The fruits and vegetables would grow in a SmartPot (SPOT) on the right. Photo credit: NASA/Bob Granath



Daniel Zukowski, a University of Colorado-Boulder graduate student, checks the status of a jalapeño pepper plant growing in a computerized SmartPot (SPOT). Telemetry in each SPOT provides data to a computer display on plant condition and it can issue watering requests. Photo credit: NASA/Bob Granath

tasks, saving time for the astronauts.

“The ‘Plants Anywhere’ approach is designed to help minimize astronaut workload,” said Hava, whose degree will focus in bioastronautics. “This keeps them free to concentrate on more important tasks.”

A year ago, the University of Colorado student team demonstrated a gardening system with plants robotically tended on a lazy Susan-like device.

“We took what we learned the past two years and applied it to this new system,” Hava said. “We decided to get away from the ‘hub concept.’ The DROPPS system gives us much more flexibility and takes advantage of unutilized space in the habitat.”

In their new system, a Remotely Operated Gardening Rover, or ROGR, travels around the habitat tending to a fleet of SmartPots, or SPOTS, which would be distributed throughout the deep-space habitat’s living space.

The SPOTS facilitate plants growing in a small, custom-designed hydroponic growth chamber with computerized systems to monitor the vegetation’s progress. Each has its own sensor run by an embedded computer.

“We envision dozens of SPOTS on a space habitat,” said Dane Larsen who is working on a master’s degree in computer science. “Telemetry in each SPOT provides data on plant condition to a computer display.”

The robots and plants are networked together, and the SPOTS have the ability to monitor their fruits’ or vegetables’ soil humidity and issue watering requests.

“The SPOTS also can measure air and water temperature, lighting provided by LEDs (light emitting diodes), as well as levels of humidity, nutrient levels and pH,” Hava said.

As each SPOT monitors and supports its plants, it can determine when ROGR needs to perform plant maintenance tasks. ROGR is a

robot on wheels, has a forklift to move SPOTS, a mechanical arm for manipulating the plants, and a fluid delivery system that can provide fresh water or water with nutrients.

Larsen explains that the system could be operated remotely or with a controller similar to those used with video games.

The ROGR robots can visit a specific plant to deliver water or to locate and grasp a fruit or vegetable. If an astronaut requests tomatoes for a salad, the system decides which specific plants have the ripest tomatoes and assigns parallel harvesting tasks to ROGR.

While living in a space habitat is basically residing in a mechanized environment, Hava says humans, by their makeup, still need to be around nature.

“We want to optimize a system allowing the humans to get psychological benefits from interacting with the plants,” she said in a 2013 Web video interview produced by the University of Colorado-Boulder. “We also want the plants to be in the astronauts’ environment so they can see them, smell them and be around them. Who doesn’t love to pick a fresh strawberry?”

For Daniel Zukowski, who also is working on a master’s in computer science, the X-Hab Challenge is an opportunity to use terrestrial-based know-how and take it to a new level.

“Before joining this project, I had been working on developing robotic farming systems,” he said. “Now I have an opportunity to bridge Earth farming systems to space.”

Hava noted that the team has benefited from support from former NASA astronaut Joe Tanner, who now is a senior instructor of aerospace engineering sciences at the University of Colorado, and Nikolaus Correll, assistant professor of computer science at the university.

Gill says involving students in ongoing NASA projects is crucial for the future.

“This is an opportunity to prepare the next



University of Colorado-Boulder graduate students Heather Hava, far left, and Daniel Zukowski, second from the left, describe a computerized SmartPot, or SPOT, which could be used to grow plants in a deep-space habitat. From the left are Hava, Zukowski, Gioia Massa NASA payload scientist for Veggie, and Tracy Gill of the NASA Center Planning and Development Directorate. Photo credit: NASA/Daniel Casper

and undergraduate student teams worked to meet a series of milestones to develop systems and concepts that could be used in future deep-space habitats. In doing so, they worked in close cooperation with members of the NASA Advanced Exploration Systems (AES) Program's Deep-Space Habitat Project team.

The challenge encourages multidisciplinary approaches, outreach

generation of engineers, scientists and explorers for our space program," he said. "They tell us how their design for the system keeps evolving. That's provided them with some real-world exposure to the systems engineering process."

Gill added that Gioia Massa, Ph.D., of the International Space Station Ground Processing and Research Project Office, Morgan Simpson of NASA Ground Processing Directorate, and Ray Wheeler, Ph.D., of the Surface Systems office in NASA's Engineering and Technology Directorate also provided guidance for the University of Colorado team. They all also helped advise the students as they developed their project and helped organize their demonstration.

"These students from the University of Colorado are an impressive group," Massa said. "This is an ambitious project, and they've put in a lot of effort to make it work."

NASA and the National Space Grant Foundation selected seven projects from six universities for the 2013-2014 X-Hab Academic Innovation Challenge.

Throughout the academic year, the graduate

efforts and partnerships with experts and industry. Participants are required to explore NASA's work on development of deep-space habitats and help the agency gather new ideas to complement its current research and development.

The University of Colorado Boulder also is among five universities selected by NASA for the 2015 X-Hab Academic Innovation Challenge. The team's project will focus on designing a Deployable Greenhouse for Food Production for deep-space missions. Other universities participating for the coming year are the University of Wisconsin-Milwaukee, University of South Alabama, University of Vermont and Oklahoma State University.

Hava says she would like to have an opportunity to apply her research on a deep-space mission.

"While the research is exciting," she said, "I would love to go to Mars and explore. I see myself as potentially being the first Mars space gardener."

I am  
GSDO

National Aeronautics and  
Space Administration



Connie Lehan  
Schedule Manager

GROUND SYSTEMS DEVELOPMENT AND OPERATIONS



more online

Kennedy Space Center  
Exploration Begins Here

# GOODNESS! GRACIOUS! GREAT BALLS OF FIRE!

## Interactive exhibit brings asteroids and meteors to life

BY LINDA HERRIDGE

Everything you might want to know about asteroids, meteors and comets is revealed at the new “Great Balls of Fire” exhibit at the Kennedy Space Center Visitor Complex. Located in the East Gallery of the IMAX Theater, the 1,500-foot exhibit officially opened July 3, complete with flashing lights, wristband glow sticks and balloons dropping.

“As we look to bring more and more activities to the visitor complex, we are focused on this exhibit and our science, technology, engineering and mathematics (STEM) activities,” said Therrin Protze, chief operating officer for Delaware North Parks and Resorts at the visitor complex.

The new attraction, scheduled to be at the visitor complex



through Jan. 4, 2015, features 10 displays, all with NASA content. A replica of the Itokawa asteroid rotates with a model of the Hayabusa spacecraft on its surface. Also on display are real meteorites. Test your knowledge about asteroids and take a trip to Jupiter in the “Asteroid Encounter.” Explore and learn about the various sizes of asteroids and see what would happen if one hit your neighborhood at the “What

Lights flickered and balloons fell as former NASA astronaut Tom Jones, left, and Therrin Protze, chief operating officer of Delaware North Parks and Resorts at the Kennedy Space Center Visitor Complex welcomed guests to the grand opening of the Great Balls of Fire exhibit. Great Balls of Fire shares the story of the origins of our solar system, asteroids and comets and their possible impacts and risks.

If It Hit My Town” interactive touch screen, and determine whether Hollywood movie clips are “Science Fact or Science Fiction Theater.”

The Comet Observatory Story Panel relates an account of comet observations throughout human history.

Examine a collection of rocks and use a series of tests to determine which ones are meteorites and which are Earth rocks in the “Is It a Rock or a Meteorite” activity. “Killer from Space: Dinosaur Extinction Display” features a giant mural explaining why scientists think an impact may be responsible for the extinction of dinosaurs. Other activities include “Sizing Up Shooting Stars” and an asteroid facts display.

Four-time NASA space shuttle astronaut Dr. Tom Jones helped open the attraction by pressing the button on a replica of an asteroid to signal the start of the excitement. Jones currently is senior research scientist for the Florida Institute for Human and Machine Cognition.

“I’m here to talk about space rocks,” Jones said. “The asteroids in our solar system have been part of our past on this planet Earth. They’re part of our future in terms of our exploration planning. And they are part of our present, in that they could present a cosmic hazard to us here on Earth.”

For billions of years in Earth’s history, asteroids and comets have been smacking into Earth periodically. Part of this process of cosmic bombardment has occurred on all of the planets. Those impacts have changed the course of life here on Earth.

“We are here as human beings today because of asteroid impacts in the past, wiping out the dinosaurs 66 million years ago and giving the mammals a chance to rise on the course of evolution on Earth,” Jones said.

Kennedy’s spaceport has been instrumental in helping us visit the moon and sending probes all around the solar system. Jones said those same techniques and technologies could be used to develop human and robotic space expeditions to prevent a future asteroid strike.

“We could use asteroids as stepping stones into the rest of the solar system. With the knowledge that we gain from the asteroids nearby, we can use them to springboard out

to the moons around Mars,” Jones said. “The two moons around Mars could very well be our base for eventually getting down to the surface of the Red Planet.”

Jones said asteroids also could offer a chance to mine raw materials, extract water, extract dirt, gravel and sand, and make a radiation shield for expeditions to Mars.

“Asteroids could be the raw materials that will give us that ticket to the stars,” Jones said. “They’re a part of our future. The young people that come here will be part of NASA’s exploration of the asteroids.

“We’re going to see Orion astronauts on the next generation of a vehicle to go to deep space from Kennedy. Young people here today



A real asteroid is on display at the new Great Balls of Fire exhibit at NASA’s Kennedy Space Center Visitor Complex. The 1,500-square-foot exhibit, located in the East Gallery of the IMAX theatre at the visitor complex, features several interactive displays, real meteorites and replica asteroid models. Photo credit: NASA/Daniel Casper

## ASTERIODS, COMETS, METEORS

### Definitions:

**Asteroid:** A relatively small, inactive, rocky body orbiting the Sun.

**Comet:** A relatively small, at times active, object whose ices can vaporize in sunlight forming an atmosphere of dust and gas and, sometimes, a tail of dust and/or gas.

**Meteoroid:** A small particle from a comet or asteroid orbiting the Sun.

**Meteor:** The light phenomena which results when a meteoroid enters the Earth's atmosphere and vaporizes; a shooting star.

**Meteorite:** A meteoroid that survives its passage through the Earth's atmosphere and lands upon the Earth's surface.

### FACTOIDS

Every day, Earth is bombarded with more than 100 tons of dust and sand-sized particles.

Asteroids populate the main asteroid belt between Mars and Jupiter. They can be as big as about 583 miles (940 kilometers) across.

About once a year, an automobile-sized asteroid hits Earth's atmosphere, creates an impressive fireball, and burns up before reaching the surface.

Every 2,000 years or so, a meteoroid the size of a football field hits Earth and causes significant damage to the area.

Only once every few million years, an object large enough to threaten Earth's civilization comes along. Impact craters on Earth, the moon and other planetary bodies are evidence of these occurrences.

(Source: NASA, Asteroid Fast Facts, March 31, 2014)

actually can take part in getting this pathway into deep space, beyond the moon, to the nearby asteroids, and eventually to Mars and beyond. It's all waiting for us. And we can start learning how to do that exploration right here at the 'Great Balls of Fire' exhibit. I'm very excited to be a part of it today," Jones said.

Protze said, "This exhibit is a fun way for kids to learn about the forces of our solar system and the impact of comets and asteroids that could happen on our planet Earth."

"Great Balls of Fire" is a production of The Space Science Institute's National Center for Interactive Learning. The former national traveling exhibition also received funding from NASA and the National Science Foundation.

The grand opening of the new Great Balls of Fire exhibit July 3 at Kennedy Space Center Visitor Complex featured remarks by former NASA astronaut Tom Jones, and Therrin Protze, chief operating officer at Delaware North Parks and Resorts. Photo credit: NASA/Daniel Casper



## Intern Team-Building



### Interns learn importance of collaboration from managers

Gather together student interns from Kennedy Space Center, add in some good advice from Center Director Bob Cabana and several senior managers, mix in a teamwork exercise, and you have a recipe for success.

More than 150 of the center's Pathways Program and Office of Education's NASA Internship, Fellowship and Scholarship (NIFS) Program interns participated in a team-building session June 27 at the Kennedy Area Recreation Services Park near the center. They networked with each other and senior managers, sharing and exchanging ideas.

"Kennedy Space Center is a great place to be," Cabana said. "Our biggest asset is our workforce. My advice to you is to learn from everyone while you are here."

For the complete story, go to <http://go.nasa.gov/1pJjLWk>

a look online

more online



# INTERNATIONAL SPACE STATION

## Researcher's Guide Series

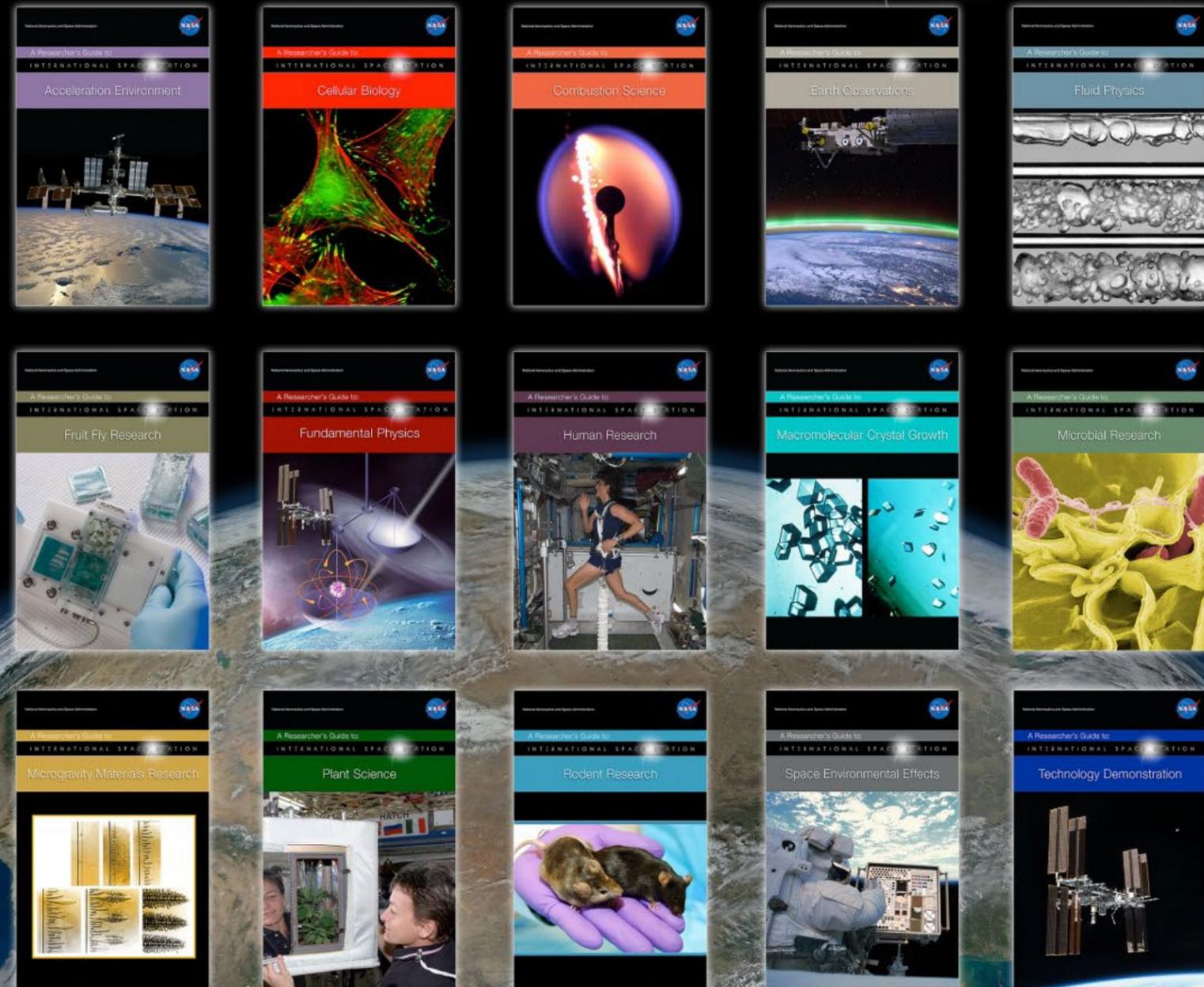
How many times do we see an innovation and think, “Of course! Why didn’t I think of that?” Our minds start turning towards thoughts of our own invention, sparking ideas and building possibilities. This type of inspiration is the concept behind the International Space Station Program Science Office’s new 15-book Researcher’s Guide Series. When scientists see what their colleagues have going on in orbit, their mental wheels may begin to speed up!

The first part of the series launched online on May 14 with three books already available for download in pdf format and online viewing. These include Technology Demonstration, Microbial Research, and Earth Observations. The rest of the books should finish rolling out by December, completing the series. The remaining topics include Plant Science, Rodent Research, Combustion Science, Fluid Physics, Fundamental Physics, Fruit Fly Research, Cellular Biology, Space Environment Effects, Human Research, Acceleration Environment, Microgravity Materials Research, and Macromolecular Crystal Growth.

As the books point out, the unique factors of the space environment create fertile grounds for scientific investigation. By removing a variable that is essentially a constant on the Earth—gravity—researchers increase the chances of discovery. They also have factors such as exposure to radiation, extreme temperatures, the vacuum of space and atomic oxygen to add to the mix. “Our goal is to encourage investigators to propose new research and potentially make discoveries that they could not make in an Earth-based lab,” said Amelia Rai, International Space Station Program Office scientific communications specialist and project manager for the research guides.

-- BY JESSICA NIMON  
ISS RESEARCH

You can read the full story at  
<http://go.nasa.gov/1nyCRI3>



# Evasive egret



A great egret sits in the tall grass on Kennedy Space Center in June. The undeveloped property on Kennedy Space Center is managed by the U.S. Fish and Wildlife Service through the Merritt Island National Wildlife Refuge. The refuge provides a habitat for a plethora of wildlife, including 330 species of birds. Photo credit: NASA/Daniel Casper

For information on the refuge, visit  
<http://www.fws.gov/merrittisland/index.html>

## Space Launch System Space Launch System



### GSDO operations and planning prepares for NASA's Space Launch System

A computer-aided design image of NASA's Space Launch System (SLS) and Orion spacecraft being stacked in the Vehicle Assembly Building high bay at Kennedy Space Center. NASA's Ground Systems Development and Operations (GSDO) Program is working to transform the center to support processing and launch of the agency's SLS and Orion spacecraft in Fiscal Year 2018. GSDO operations and planning is an integral component to achieving this goal. Image credit: NASA

For the complete story, go to <http://1.usa.gov/VTwxKP>

a look online

more online



# America's **Next Giant Leap**

National Aeronautics and Space Administration

John F. Kennedy Space Center  
Kennedy Space Center, FL 32899

[www.nasa.gov](http://www.nasa.gov)

SP-2014-05-144-KSC

To learn more about NASA's Next Giant Leap, go to  
<http://go.nasa.gov/1rSPwkj>

SPACEPORT MAGAZINE