



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



**Solar Eclipse
Captivates Nation**

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COVER: Spectators in the Battery soccer stadium in Charleston, South Carolina, view the solar eclipse Aug. 21, 2017. Charleston was one of the cities across the country that experienced a full solar eclipse. Education specialists from Kennedy Space Center hosted events and solar eclipse presentations at several locations in Charleston. Photo credit: Bsports Entertainment/Sarah Cardamone

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NASA'S LAUNCH SCHEDULE

Date: Sept. 12
Mission: Expedition 53 Launch
Description: NASA astronauts Joe Acaba and Mark Vande Hei and cosmonaut Alexander Misurkin of the Russian space agency Roscosmos will launch to the International Space Station aboard the Soyuz MS-06 spacecraft from the Baikonur Cosmodrome in Kazakhstan.
<https://go.nasa.gov/2rkRChR>

Date: Nov. 10
Mission: Joint Polar Satellite System-1 (JPSS-1)
Description: JPSS is a next-generation environmental satellite system. It is a collaborative program between the National Oceanic and Atmospheric Administration (NOAA) and NASA. The polar-orbiting weather satellite will launch from Vandenberg Air Force Base in California on a United Launch Alliance Delta II rocket.
<https://go.nasa.gov/2rW4DCf>

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

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

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PHOTO of the MONTH



Phil Weber, a senior technical integration manager in the Ground Systems Development and Operations Program, snapped this photograph through his office window Aug. 2, 2017, as storm clouds surrounded the Vehicle Assembly Building.

MOON CROSSING

Education events add to solar eclipse viewing experience

BY LINDA HERRIDGE



For the first time in 99 years, a total solar eclipse traveled from coast to coast in the U.S., across portions of 14 states. The Aug. 21 event was witnessed by millions of people around the country as the Moon passed between Earth and the midday Sun. A partial eclipse was viewable across the remainder of the northern continent along with parts of South America, Africa and Europe.

In a 70-mile-wide diagonal path that began on the west coast in Lincoln Bend, Oregon, crossing along the way to Homestead National Monument in Nebraska, and ending at Charleston, South Carolina, on the eastern seaboard, the area of total eclipse treated viewers to about two minutes of darkness in the middle of the day. The longest duration of the eclipse was near Carbondale, Illinois.

It may be just as awe-inspiring to learn about a solar eclipse as it is to view one. Educators and specialists from NASA Kennedy Space Center's Education Office traveled to Charleston, an area of solar eclipse totality. The group hosted several events prior to the eclipse. On Aug. 19, the team was at the Charleston Aquarium, the Charleston Museum and the Charleston Library. They provided three scheduled presentations at each venue and reached nearly 2,000 interested participants. The team, along with representatives from the Ground Systems Development and Operations Program and the Launch Services Program, delivered eclipse presentations, answered questions, and distributed NASA information and solar eclipse viewing glasses.

The Sun is seen as it rises behind Jack Mountain ahead of the solar eclipse, Aug. 21, 2017, at Ross Lake in the Northern Cascades National Park in Washington. A total solar eclipse swept across a narrow portion of the contiguous United States from Lincoln Beach, Oregon, to Charleston, South Carolina. A partial solar eclipse was visible across the entire North American continent along with parts of South America, Africa, and Europe. Photo Credit: NASA/Bill Ingalls

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"Solar eclipse viewing glasses were a hot commodity around the city," said Lester Morales, NASA education specialist. "We were asked for them everywhere we went, so we started carrying pairs of the glasses with us."

On eclipse day, Aug. 21, the Kennedy team was at three locations: the MUSC Health soccer stadium on Daniels Island, the River Dogs baseball stadium in Charleston, and the USS Yorktown on Patriots Point. The education team at River Dogs joined up with NASA's Digital Learning Network, or DLN, an education and subject-matter expert team from Goddard Space Flight Center in Greenbelt, Maryland, and the International Space Station trailer from Johnson Space Center in Houston.

NASA program information was distributed and solar eclipse-related educational hands-on activities were provided to more than 4,000 guests. DLN had live streaming video connections with 5,274 people on eclipse day, and the DLiNfo Channel stream had more than 340,000 unique views.

Over at MUSC Health Stadium, home to the Battery soccer team, the Kennedy team provided NASA program information and solar eclipse-related educational hands-on activities to more than 5,000 guests. NASA astronaut Doug "Wheels" Wheelock was on hand to greet visitors and answer questions. He also explained the phases of the solar eclipse to the crowd for the duration of the eclipse.

Representatives from GSDO and the Launch Services Program were aboard the USS Yorktown. They joined NASA's Chief Technologist Douglas Terrior and Gordon Chin, an astrophysicist from Goddard, providing presentations on NASA missions to more than 3,000 visitors and national media outlets.

Denise Coleman, NASA Education Projects Division, estimates they reached more than 14,000 adults and students during the two days of solar eclipse outreach events.

"It was definitely worth almost a year of planning to be able to work with such an outstanding Kennedy team and all of our new contacts in the Charleston area," Coleman said. "I don't think we will ever forget it. And even though we were totally exhausted as we drove back to Kennedy, we started talking about where the 2024 eclipse will occur and doing this all over again."

At Kennedy Space Center, hundreds of workers gathered at an outdoor recreation area to view the partial eclipse, which reached its highest point, about 85 percent coverage, a few minutes before 3 p.m.

Several members of Kennedy's Amateur Astronomers Club traveled north to witness a full eclipse. Mark Femminineo, a GSDO upper stage flight integration engineer, was one of them. He had

never seen a total solar eclipse. He traveled to Mt. Juliet, Tennessee, just east of Nashville, and viewed it through a six-inch telescope with a filter.

"This was my first, and it didn't disappoint," Femminineo said. "It was unquestionably the most spectacular celestial event you can possibly see. I highly recommend you do whatever it takes to see one of these at least once in your life."

Nearby, the Kennedy Space Center Visitor Complex hosted a solar eclipse day for visitors. Complimentary certified eclipse viewing glasses were distributed. Space experts were on site to answer questions and offer commentary throughout the viewing event. Live content from across the U.S. was streamed live on the visitor complex's Jumbotron. Guest speakers included astronaut John-David Bartoe and communicator Jeff Lucas.

Now, we'll have to wait seven more years for another solar eclipse in the United States. In 2024, its path will be different, but will once again cross over Carbondale, Illinois.



From the Kennedy Space Center Visitor Complex, guests joined Americans from coast to coast following the solar eclipse Aug. 21. Although a partial eclipse on Florida's Space Coast, young and old alike found many ways to watch the rare astronomical event. As the Moon passed between Earth and the midday Sun, a shadow moved across the landscape. The 70-mile-wide totality path, or "umbral cone" -- where the entire Sun vanished behind the Moon -- stretched across 14 states, from Oregon to South Carolina. Photo credit: NASA/Ben Smegelsky

View solar eclipse photos at
<https://www.nasa.gov/eclipsephotos>
and
<https://www.flickr.com/photos/nasahqphoto>.



This composite image of 11 pictures shows the progression of a total solar eclipse at Madras High School in Madras, Oregon on Monday, Aug. 21, 2017. A total solar eclipse swept across a narrow portion of the contiguous United States from Lincoln Beach, Oregon, to Charleston, South Carolina. A partial solar eclipse was visible across the entire North American continent along with parts of South America, Africa and Europe. Photo Credit: NASA/Aubrey Gemignani



NASA Acting Administrator Robert Lightfoot speaks to employees during a town hall meeting in the conference room of Operations Support Building II on Aug. 15, 2017. To the right is Deputy Associate Administrator Lesa Roe. Photo credit: NASA/Kim Shiflett

Lightfoot updates Kennedy employees in town hall meeting

BY BOB GRANATH

NASA's Acting Administrator Robert Lightfoot was joined on Aug. 15 by Deputy Associate Administrator Lesa Roe and Kennedy Space Center Director Bob Cabana for a town hall meeting with employees at the Florida Spaceport. During the gathering, they discussed continued progress toward the agency's primary goals.

Lightfoot noted that the event came the day after a Falcon 9 rocket launched a Dragon spacecraft on the SpaceX CRS-12 mission to resupply the **International Space Station**.

"We had a great day yesterday," he said. "I'm really proud of what you guys are doing and what you are doing for the agency."

In his presentation, Lightfoot stated that his purpose was to update employees on where NASA is headed and describe the executive branch group established to help bring a renewed sense of purpose to America's space policy.

"We're getting started with the National Space Council," he said. "I think this is a really good opportunity to talk about what we're going to do at NASA."

During his recent **visit to Kennedy**, Vice President Mike Pence discussed President Donald Trump's executive order signed on June 30, re-establishing the National Space Council. With Pence as chair, the group's purpose is to coordinate all aspects of the nation's space power and unlock new opportunities.

Read the full story at <https://go.nasa.gov/2woXevY>.



This illustration depicts NASA's Tracking and Data Relay Satellite, TDRS-M, in orbit. The TDRS system provides a communication vital link to the International Space Station, the Hubble Space Telescope and a host of Earth sciences satellites. Photo credit: NASA's Goddard Space Flight Center

NEWEST ARRIVAL

TDRS-M continues vital communications link to space

BY BOB GRANATH

In spaceflight, communication is crucial. Whether it's the [International Space Station](#) linking to the Mission Control Center at NASA's Johnson Space Center in Houston or interstellar images being transmitted to Earth by the [Hubble Space Telescope](#), the vital link is NASA's [Tracking and Data Relay Satellite](#) (TDRS) system.

The latest addition to join this system is the [TDRS-M](#) satellite. The new spacecraft lifted off atop a United Launch Alliance (ULA) Atlas V rocket from Space Launch Complex 41 at Cape Canaveral Air Force Station in Florida at 8:29 a.m. EDT on Aug. 18.

TDRS-M is the final spacecraft of three in the third generation of Tracking and Data Relay Satellites. NASA now is developing the

next generation space communications architecture, working to identify creative solutions to meet future mission needs.

Management of Atlas V operations for TDRS-M is managed by NASA's [Launch Services Program](#). LSP oversees the agency's efforts to commercially provide rockets for specific missions. The team also manages the overall launch effort, including overseeing development and integration of the rocket with the spacecraft.

TDRS-M will allow NASA's Space Network constellation of satellites to continue supporting space communications well into the 2020s.

According to Kennedy's launch director, Tim Dunn, the network consists of [TDRS satellites](#) that transmit data to and from NASA centers on Earth for agency missions and expendable launch vehicles.

"The TDRS constellation has been revolutionary in simplifying space communications," Dunn said. "It is a huge upgrade from when we had to use many ground stations around the world to relay data from space. In addition to Hubble and the space station, TDRS satellites provide critical communication support to the space station and a host of Earth sciences satellites."

Beginning with the flights of Mercury, Gemini and Apollo in the early 1960s, NASA required a worldwide network of tracking stations to stay in touch with orbiting astronauts. By the early 1970s, the agency needed more than 50 spacecraft to supplement ground stations in providing spacecraft communications. Even so, the tracking network only provided contact about 15 percent of the time.

The TDRS project was established in 1973 to determine a way to deliver around-the-clock communications with NASA's most crucial missions in low-Earth orbit, providing higher rates of data exchange. TDRS satellites have played a role supporting spaceflight since the first was deployed from the STS-6 space shuttle mission on April 4, 1983.

The TDRS-M spacecraft was built by Boeing Space and Intelligence Systems of El Segundo, California, and arrived on Florida's Space Coast June 23. After a U.S. Air Force transport aircraft touched down at Space Coast Regional Airport in Titusville, Florida, the satellite was transported inside its shipping container to the nearby Astrotech facility for preflight processing.

Meanwhile, the Atlas V first stage booster and Centaur upper stage arrived aboard ULA's Mariner cargo ship at the Army Outpost wharf at Port Canaveral, Florida, June 27. The booster then was transported to the hangar at the Atlas Spaceflight Operations Center (ASOC), located south of Space Launch Complex 41. The Centaur moved to the Delta Operations Center, also at the Cape.

When preflight processing at the ASOC was complete, the Atlas V booster was raised in the Vertical Integration Facility (VIF) at pad 41 on July 12 and the Centaur stacked on top a day later. After the TDRS-M satellite was readied in the Astrotech facility, it was encapsulated in its payload fairing and transported to the VIF and mounted on the Centaur for final testing prior to launch.

Now in orbit, the TDRS spacecraft was positioned 22,300 miles above Earth and provide near-constant communication links between the ground and orbiting satellites.

"In today's world of instant data and communications requirements, it would be quite a task to rely on multiple space-to-ground relays using worldwide ground stations," Dunn said. "Fortunately we have TDRS today. The TDRS Network is a vital national asset."



A United Launch Alliance Atlas V rocket lifts off Aug. 18, 2017, from Space Launch Complex 41 at Cape Canaveral Air Force Station in Florida, with NASA's Tracking and Data Relay Satellite, TDRS-M. Liftoff was at 8:29 a.m. EDT. Photo credit: NASA/Tony Gray and Sandra Joseph

INTERIM CRYOGENIC PROPULSION STAGE MOVES TO SPACE STATION PROCESSING FACILITY

BY LINDA HERRIDGE

The Interim Cryogenic Propulsion Stage (ICPS) is the first segment for NASA's Space Launch System (SLS) rocket to arrive at the Kennedy Space Center. It was transported from the United Launch Alliance (ULA) facility at Cape Canaveral Air Force Station, where it had been undergoing final testing and checkout since arriving in February, to the Space Station Processing Facility at the center July 26.

Stacking of the rocket will occur in the Vehicle Assembly Building (VAB). The ICPS will be located at the very top of the SLS, just below the Orion capsule. During Exploration Mission-1, NASA's first test mission of the SLS rocket and Orion, the ICPS, filled with liquid oxygen and liquid hydrogen, will give Orion the big in-space push needed to fly beyond the Moon before returning to Earth.

The ICPS was designed and built by ULA in Decatur, Alabama, and Boeing in Huntsville, Alabama. The propulsion stage will be cleaned and maintained and remain in the high bay at the Space Station Processing Facility and moved to the VAB when it is time for stacking operations.

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Service platforms arrive for Space Launch System booster engines

BY LINDA HERRIDGE

New service platforms for NASA's Space Launch System (SLS) booster engines arrived at the agency's Kennedy Space Center in Florida. The platforms were transported on two flatbed trucks from fabricator Met-Con Inc. in Cocoa, Florida. They were offloaded and stored inside the Vehicle Assembly Building (VAB).

The platforms will be used for processing and checkout of the engines for the SLS' twin five-segment solid rocket boosters for Exploration Mission-1 (EM-1). The boosters, in combination with the rocket's four RS-25 engines, will produce more than 8 million pounds of thrust at liftoff.

The first SLS mission, EM-1, will launch an uncrewed Orion spacecraft to a stable orbit beyond the Moon and bring it back to Earth for a splashdown in the Pacific Ocean. The mission will demonstrate the integrated system performance of the rocket, Orion spacecraft and ground support teams prior to a crewed flight.

A flatbed truck carrying the first of two new service platforms for NASA's Space Launch System booster engines arrives at the Vehicle Assembly Building at Kennedy Space Center on July 31, 2017. Photo credit: NASA/Bill White





KENNEDY SPACE CENTER
Exploration Begins Here

Sam Talluto

Deputy Project Manager, Mobile Launcher Element

My name is Sam Talluto. I am the Mobile Launcher Element deputy project manager in the Ground Systems Development and Operations Program (GSDO) at NASA's Kennedy Space Center in Florida. I've been with GSDO since August 2011.

I am responsible for the design and development of the mobile launcher (ML), including the structure, numerous subsystems and umbilical arms that are located throughout the ML. My primary focus for the last two years has been to work with the subsystems to complete the design of the ground support equipment (GSE) installations, and work with the contractor to install the GSE when it arrives at the ML parksite.

I started working with McDonnell Douglas (now Boeing) in 1996. I was a field construction engineer during the design and development of Launch Complex 37 at Cape Canaveral Air Force Station, which continues to launch the Delta IV rocket. I also worked for ASRC at the center's Launch Equipment Test Facility, where we tested space shuttle GSE hardware. When the space shuttle was

retired, we began the renovation of facilities to support NASA's Space Launch System Program.

One of my most memorable achievements in support of GSDO was when I received an Exceptional Achievement Medal in 2016. I was able to bring my family on center for the award presentation.

I'm looking forward to the launch of the SLS rocket on Exploration Mission-1. The countdown to T-0, the roaring of the engines as the rocket lifts off of the ML, and knowing that history is being made before our eyes.

I earned a Bachelor of Science in civil engineering in 1996, and a master's in industrial engineering in 1999, both from the University of Central Florida.

My father worked for NASA from 1966 to 1997, so I've always been interested in space and in working at Kennedy Space Center.

The advice I would give students who are interested in a career similar to mine is to take pride in your work, work hard and enjoy life with your family and friends.

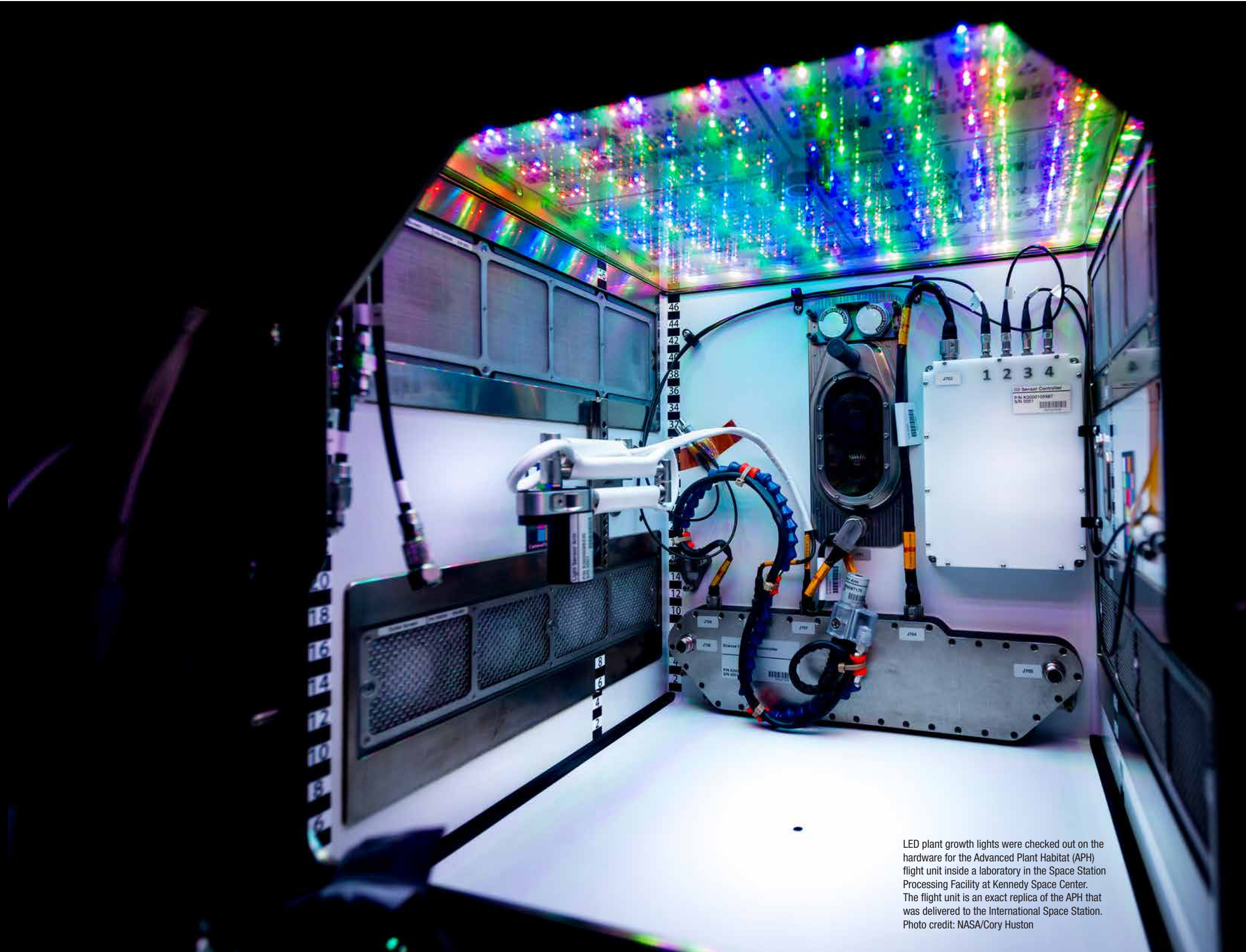
Sam Talluto
Deputy Project Manager
Mobile Launcher Element

Advanced Plant Habitat readied for science

BY AMANDA GRIFFIN

The Advanced Plant Habitat Flight Unit No. 1 that will be used for ground testing the agency's newest plant habitat arrived at Kennedy Space Center on July 17. Over the past couple of weeks, the unit has undergone numerous inspections and checkout procedures and now is undergoing an Experiment Verification Test. This test, started on July 27, will allow the ground team at Kennedy to run through the procedures of the future Plant Habitat 01 Mission, or PH-01, that will grow aboard the International Space Station later this year. Both the test and the actual mission will grow Arabidopsis seeds, which are small flowering plants related to cabbage and mustard.

The Advanced Plant Habitat was sent to the space station in two shipments -- on the Orbital ATK OA-7 and SpaceX CRS-11 resupply missions. Once it is set up, it will be a fully automated facility that will be used to conduct plant bioscience research. The Advanced Plant Habitat is an enclosed, closed-loop system with an environmentally controlled chamber. The habitat will use red, blue, green and broad-spectrum white LED lights and have 180 sensors to relay information back to the team at Kennedy. The habitat is scheduled to be activated aboard the orbiting laboratory this fall, with PH-01 beginning in late October.



LED plant growth lights were checked out on the hardware for the Advanced Plant Habitat (APH) flight unit inside a laboratory in the Space Station Processing Facility at Kennedy Space Center. The flight unit is an exact replica of the APH that was delivered to the International Space Station. Photo credit: NASA/Cory Huston

PLANTING SEEDS OF OPPORTUNITY

Kennedy's food production team holds information exchange

BY KAY GRINTER

What's for dinner? As astronauts spend longer periods of time in orbit and journey into deep space beyond the Moon and eventually to Mars, that question will become more and more challenging to answer.

The food production team at NASA's **Kennedy Space Center** in Florida recently held a two-day information exchange with fellow subject-matter experts in the commercial and academic sectors to discuss how their solutions could help NASA solve some of the most difficult challenges in food production system development. "Brainstorming Innovative Open Source Approaches to Food Production" featured sessions on controlled-environment agriculture, space agriculture and related areas.

Kennedy's Long Duration Food Production project manager Ralph Fritsche was one of the event organizers and presenters. "We were planting the seeds of opportunity by having this meeting," Fritsche said. "This is a super-great opportunity to actually reach out to people who potentially could make a difference in the research and the type of work that we're doing here."

The information exchange session allowed NASA researchers to meet with new stakeholders and discuss the gaps in knowledge that need to be filled before safe and sustainable food production in space can be achieved.

"The primary challenge we face now is one that the science community has wrestled with for several decades and that is how to provide the root zone of plants with the required quantities of water and oxygen," Fritsche explained. "Water behaves quite differently in microgravity and the tendency is for roots either to be smothered in water or deprived of it completely."

Isha Datar, from the New Harvest Group, a nonprofit research institute looking at cellular agriculture with open collaboration, found the interaction stimulating. "I think what was really exciting to me was the enthusiasm about open source technologies and enthusiasm about working on collaborative projects," she said. "I'm going to think hard about what those projects could be and how we could design things that could be helpful for everybody." Open source technologies are any of a range of potentially compatible technologies that may benefit the research and systems under development and whose information, such as schematics or materials, is freely available to the public for use, improvement or adaptation.



NASA interns Jessica Scotten, left, and Ayla Grandpre water plants in the Veggie hardware in Kennedy Space Center's ISS environment simulator chamber. Mizuna mustard, Outredgeous lettuce and Waldmann's green lettuce are growing in Veggie. Photo credit: NASA/Cory Huston

The representative from Farmbot, inventors of a fully customizable, open source farming machine for precision agriculture, Rory Aronson, appreciated the opportunity for collaboration. "I knew that there were going to be a few groups that we had heard of, that we had talked with a little bit," he said "but you know what was really fun over the last two days was actually collaborating with and discussing these big challenges with all these other groups that are working in very similar ways to us." Precision agriculture targets the selected plants in order to optimize all the factors that would enhance their growth and productivity while using minimum resources, such as water, light and nutrients.

"There are other hardware technology issues as well," Fritsche said, "such as packaging a system within the volume constraint provided by the vehicle while maximizing the space for plant growth, ensuring the proper light spectrum and intensity for optimum plant growth and effective and efficient nutrient delivery." Some of the research may even result in so-called "designer plants."

Miami's Fairchild Tropical Botanic Garden delegate, Amy Padolf, saw the potential for future teamwork. "We're experts at plants, varieties, growth, horticulture, agriculture, but to meet people who can help us figure out how to collect the data, figure out how to utilize that data, how to share that data, how to find people



Bryan Onate, Advanced Plant Habitat project manager, with the Exploration Research and Technology Directorate, brainstorms innovative approaches to food production with industry representative inside a laboratory at the Space Station Processing Facility at Kennedy Space Center in Florida. Photo credit: NASA/Bill White

that we wouldn't have known how to get in touch with otherwise to be able to help us with solutions to those problems that we face" is invaluable in Padolf's opinion.

Other participants included representatives from the MIT Media Lab Open Agriculture Initiative and the Buzz Aldrin Space Institute at the Florida Institute of Technology, as well as faculty from Florida Tech who have been assisting Kennedy in the development and testing of aspects of food production systems as part of an ongoing Space Act Agreement.

Opportunities to collaborate with other types of agri-businesses also may be beneficial to NASA as we move ahead to consider surface food production concepts, especially on Mars where Martian **regolith may be a potential growth medium**. However, regolith is inorganic, and we will need to understand how it can be remediated of its negative components and then augmented

with the minerals and nutrients required to make it viable for plant growth.

Dr. Gioia Massa, NASA payload scientist for the **Veggie** plant growth chamber currently in use on the International Space Station and another of the event organizers, is encouraged by the success of the exchange: "This event provided an excellent opportunity to infuse new perspectives and creativity into our work on space food production. We look forward to continuing the relationships with these groups with new collaborative ventures to help us more effectively provide food for astronauts on upcoming exploration missions."

As evidence of the productivity of the dialogs, Kennedy Space Center is working toward more formal collaborations with the various groups in attendance.

POWER UP

Systems tests prepare Orion for deep space exploration

BY LINDA HERRIDGE

When a new car is built, all of its systems are checked and tested to confirm they are working before the vehicle rolls off the assembly line. The same could be said for the Orion spacecraft that will launch atop the agency's **Space Launch System** (SLS) rocket on Exploration Mission-1 (EM-1).

A huge difference is that Orion will hurtle beyond the Moon at a speedy 25,000 mph for a three-week mission that requires a space processor capable of operating with guaranteed reliability, in a high radiation environment tens of thousands of miles in deep space. The processor will need to execute thousands of commands and sequences at 480,000,000 instructions per second to control the hundreds of spacecraft systems and components and ensure crew safety and mission success.

NASA and Lockheed Martin engineers and technicians began integrated spacecraft power-up testing Aug. 11 on the EM-1 **Orion** crew module in the Neil Armstrong Operations and Checkout Building high bay at Kennedy Space Center in Florida. The high bay is very similar to a production line, with enclosed clean rooms, test cells and test stands where the work to prepare the spacecraft for flight is performed.

During the initial power-on tests, engineers and technicians connected the vehicle management computers to Orion's power and data units to ensure the systems communicate precisely with one another to accurately route power and functional commands throughout the spacecraft for the duration of a deep space exploration mission.

In spaceflight, Orion will generate power through its four solar array wings which collectively hold about 15,000 solar cells that can harness enough electricity to power eight three-bedroom homes. The power and data units then distribute that power as needed throughout the spacecraft.

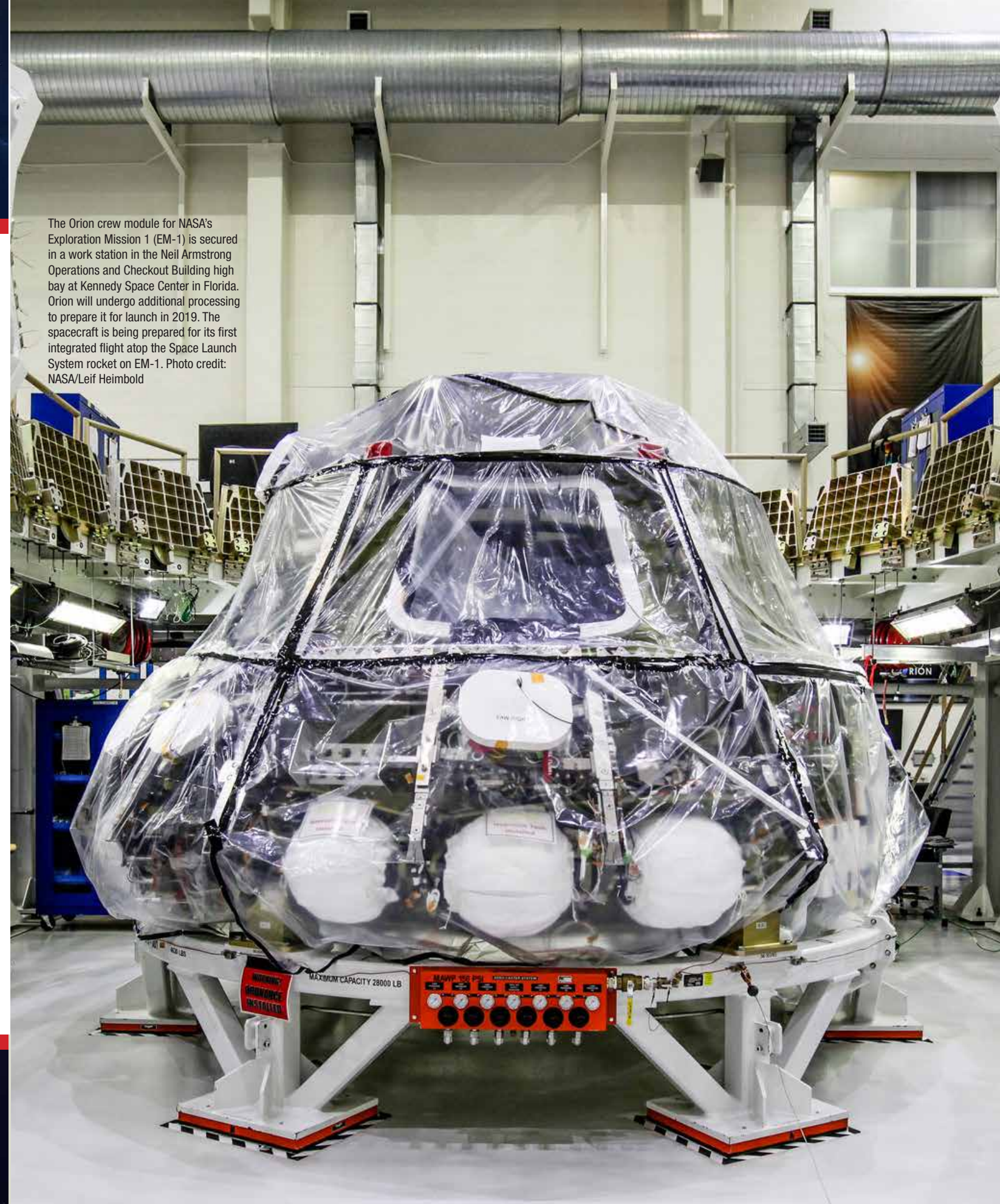
"The initial power-on procedure verified the health and status of Orion's core computers and power and data units and marks the beginning of critical spacecraft subsystem tests to get us ready for flight," said Mark Kirasich, NASA Orion program manager. "Our test team, ground support equipment and flight systems all performed remarkably well during the test. This is a major milestone for Orion and for our long-range deep space exploration plans."

The initial power-on is the first time a simulated version of the vehicle management computers and the PDUs in the crew module were turned on, loaded with flight software and tested.

"The spacecraft's power and data units and core computers will continue to undergo additional testing of various components over the next two to three months," said Rafael Garcia, NASA Orion program test and verification lead at Kennedy.

Orion will launch atop the agency's Space Launch System rocket for an uncrewed mission traveling 40,000 miles beyond the Moon and returning to Earth with a Pacific Ocean splashdown. The mission will demonstrate the integrated system performance of the rocket, Orion spacecraft and ground support teams prior to the first **flight with astronauts** aboard.

The Orion crew module for NASA's Exploration Mission 1 (EM-1) is secured in a work station in the Neil Armstrong Operations and Checkout Building high bay at Kennedy Space Center in Florida. Orion will undergo additional processing to prepare it for launch in 2019. The spacecraft is being prepared for its first integrated flight atop the Space Launch System rocket on EM-1. Photo credit: NASA/Leif Heimbald



BENEFITS OF RESEARCH



Commercial Crew missions offer research bonanza for space station

BY STEVEN SICELOFF

The addition of Boeing Starliners and SpaceX Crew Dragons to the manifest of spacecraft heading to the International Space Station in the near future raises more than the opportunities for astronauts to fly to and from space aboard American spacecraft. It also increases the amount of science and broadens the research that can be performed aboard the orbiting laboratory.

That's because the new generation of human-rated spacecraft are being designed to carry time-critical science to and from the space station along with astronauts. Researchers will be able to work with astronauts aboard the station to undertake a wide array of different science investigations and will benefit from the increased opportunity to see their research returned back to Earth for continued examination.

The spacecraft also will aid in the goal of establishing and maintaining a crew of seven astronauts, which could increase the research time in microgravity. Mission planners anticipate that increasing the crew size on the U.S. segment by just one crew member could effectively double the amount of time dedicated each week to research.

The space station, which has been permanently crewed since November 2000, offers humanity the only space-borne laboratory of its kind. NASA has used it for a range of studies including particle physics, biology, astronomy and engineering. Experiments to study Alzheimer's proteins, grow plants and survey Earth's atmosphere have been conducted from the orbiting platform. With NASA focused on the challenges of sending astronauts to deep space, much of the science conducted on the station centers on finding answers to questions of health after long durations in orbit and on lowering



NASA astronaut Peggy Whitson harvests Tokyo "Bekana" cabbage plants in the Veggie plant growth system on the International Space Station. Photo credit: NASA

radiation dangers. The station also is home to experiments that benefit people on Earth in numerous ways.

Aside from cargo-only versions of the Dragon spacecraft and the soon-to-fly Sierra Nevada Corp. Dream Chaser, the other supply ships that go to the space station burn up in the atmosphere after their missions. Therefore, they are loaded with trash and equipment that is no longer useful. For researchers on Earth, though, the chance to look at specimens grown in orbit, such as microscopic protein crystals, reveal details that are not always picked up in photos taken in orbit.

Designed to fly more people into space, the Starliners and Crew Dragons will fly up to four astronauts at a time on NASA missions, plus more than 200 pounds of cargo. At the end of their missions, the spacecraft can be loaded with returning experiments or other gear that needs to be saved on Earth rather than discarded. In other words, the research can get a ride home with the astronauts.



The two-stage Falcon 9 launch vehicle lifted off Launch Complex 39A at Kennedy Space Center on Aug. 14, 2017, carrying the Dragon resupply spacecraft to the International Space Station. Liftoff was at 12:31 p.m. EDT. On its 12th commercial resupply services mission to the International Space Station, Dragon delivered more than 6,400 pounds of supplies and new science experiments and equipment for technology research. Photo credit: NASA/Tony Gray and Sandra Joseph

FOSTERING INNOVATION

New Ideas Challenge spurs 'out of the box' thinking

BY KAY GRINTER

Six innovation-focused organizations at NASA's Kennedy Space Center put on their thinking caps this month to compete in the center's New Ideas Challenge. The competition is funded by NASA's Office of the Chief Technologist to foster innovation by providing \$50,000 of Fiscal Year 2017 funding to each NASA field center to spur "out of the box" thinking.

The Exploration Research and Technology Programs Directorate is engaging in discussions with stakeholders in Kennedy's programs to capture any of their needs that could be addressed through innovation and applied research. This dialogue provided a nucleus of project concepts for the New Ideas Challenge.

Kennedy's six teams were made up of techies from the Utilization and Life Sciences Office, Spaceport Systems Branch, Flight Technology Branch, Applied Science Branch, Advanced Engineering Development Branch and KSC Spaceport Innovators. Each team was given \$7,000 and two weeks to develop their idea or concept.

Innovation is multifaceted, acknowledged Greg Clements, acting assistant chief technologist at Kennedy. "Innovation is an attitude and a mindset. It is the application of creative ideas to improve and generate value for an organization," he said. "Successful organizations have innovation deep-rooted in their culture, emphasizing behaviors such as teamwork, initiative, open communication, informed risk-taking, continuous learning, adaptability, knowledge sharing and the courage to be yourself."

The concepts developed were presented Aug. 14 to determine the best idea brought forward. The evaluating panel included representatives from Kennedy's chief technologist's office, the teams themselves and other innovation specialists.

The diverse ideas developed were "Astronaut Fitness Class/ Innovation Spaces" by the Spaceport Innovators, "In-K Space, Recycling Plant Biomass for use as Printing Material in 3-D Printing" by the Utilization and Life Sciences Office, "Aeroponics Research for Microgravity Growth Chambers" by the Flight

Technology and the Applied Science Branches, "High Accuracy Dissolved Oxygen Optical Sensor for Plant Growth in Space" by the Advanced Engineering Development Branch, and "Ascent Stage Propellant System Test Bed" by the Spaceport Systems Branch.

"It was hard to single out a winner because they are all innovative and beneficial to KSC's programs and goals," said one of the 14 judges, Meredith Reeves, the new technology representative for Technology Transfer at Kennedy.

When the judging was over, the collaborative effort by the Flight Technology and Applied Science Branches, "Aeroponics Research for Microgravity Growth Chambers," came out on top.

The winning team acknowledged that efficient food production is critically important to long-duration space exploration but that aeroponics, a plant-cultivation approach in which the roots hang suspended in the air while a nutrient solution is delivered in a fine mist, has obstacles to overcome, including root rot and irregular root growth, before it can be used for plant cultivation in space.

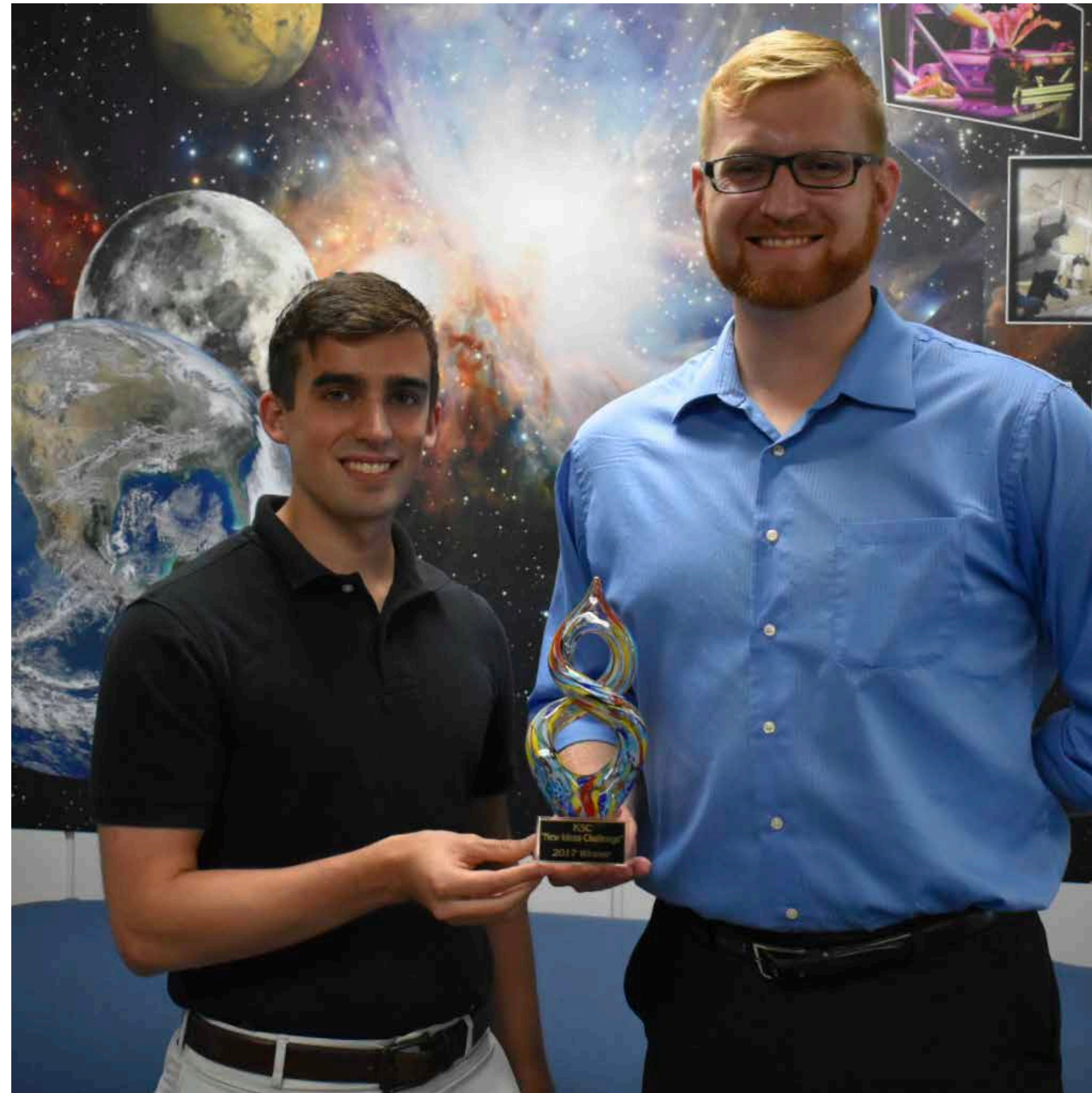
To direct the team's thinking, Paul Mackey, a physics researcher in the Flight Technology Branch, suggested that aeroponics might work in space if electrostatic principles could be incorporated into the technique.

"If we applied the electrostatic theory to where opposite charges attract, it could possibly work," explained Duncan Manor II, an intern assigned to the Flight Technology branch and member of the winning team. The problem yet to be solved is how to "cause the attraction between water particles and the plant itself," he said.

Along with "bragging rights," the winning team will receive an additional \$7,000 to further implement their idea.

"Plants are not usually our thing, but there's this great avenue for us to collaborate with the plant folks," added teammate Dylan Carter, another intern with Flight Technology.

Clements hopes that the challenge will continue in the coming years and expand so that winning ideas from the various centers can compete to identify the best new idea from across the agency.



Kennedy Space Center's New Ideas Challenge winners, from left are interns Dylan Carter and Duncan Manor II. Photo credit: NASA/Jennifer Marquez

CAREER PREP

In the Space Life Sciences Laboratory at Kennedy Space Center, student interns such as Payton Barnwell are joining agency scientists, contributing in the area of plant growth research for food production in space. Barnwell is a mechanical engineering and nanotechnology major at Florida Polytechnic University. Photo credit: NASA/Bill White



Internships help train Kennedy's future workforce

BY BOB GRANATH

For most of NASA's 60 years, students have been an integral part of NASA's workforce supporting the nation's efforts to explore space. The agency attracts its future workforce through the NASA Internship, Fellowships and Scholarships, or NIFS, Program.

According to Grace Johnson, NIFS coordinator at NASA's Kennedy Space Center in Florida, it's about preparing high school, college and graduate students for careers.

"We want to introduce them to real-world experiences and the possibility of long-term employment with NASA, contractors or other areas of the aerospace industry," she said. "We are training our future workforce."

The program operates year-round. This summer there are 74 interns serving in various areas of the Florida spaceport.

"We hope some of the interns will bring fresh ideas and concepts for new technology," Johnson said.

Khoa Vo, chief of Kennedy's Spaceport Systems Branch, explained interns in his area are doing exactly that.

"The talent level is incredible," he said. "They bring new ideas and different perspectives that fit in very well with our Swamp Works Laboratory being an innovation incubator."

Those working in Vo's area include Andrew Thoesen, a graduate student studying mechanical engineering at Arizona State University.

"I want to investigate the performance of the RASSOR 2.0 robot and help develop simulations which assist in designing parts for usage in granular media," Thoesen said. "Right now there is a pathway to Mars, and it includes in-situ resource utilization using robots like RASSOR. I would like to provide some insight which can help guide the Swamp Works in the right direction for further development of their technology."

NASA scientists and engineers also are developing systems to harness abundant resources available in the solar system to support these pioneering missions. The practice is called in-situ resource utilization, or ISRU.

RASSOR, the Regolith Advanced Surface Systems Operations Robot, is designed to operate on the surface of Mars. Robots like RASSOR will dig down into the regolith, mining for elements that could be useful for purposes such as rocket fuel.

Dr. Matthew Mickens, Dr. Gioia Massa, and Matt Romeyn work on Kennedy's Life Sciences research. They are serving as mentors to four interns contributing in the area of plant growth research for food production in space. Mickens explained that interns often assist when extra help is needed.

"As scientists, whenever we are limited by time or creativity, that is where the interns step in for us," Mickens said. "I am amazed at how they tend to do everything together. Their comradery is

impressive and really demonstrates the kind of collaborative approach that has led to NASA's past and present successes."

One of the interns working in Life Sciences research is Ayla Grandpre, a senior majoring in computer science and chemistry at Rocky Mountain College in Billings, Montana. This summer she is studying potential space crops and ways to pollinate flowers in space, which will give astronauts the option to grow fruit.

"I hope to further space exploration by helping grow and develop new crops for long-term space travel," she said. "Being involved in the process of growing and harvesting food for space is truly an honor."

Vo added that as a mentor for student interns, he wants to give them work that will stretch their learning experiences.

"We do provide students with challenging work assignments and teach them skills that are not taught in school," he said.

That's what Peter Laux is doing this summer while working in Space Launch System (SLS) Booster Safety and Mission Assurance. He is a senior aerospace engineering major at the University of Alabama. The SLS is NASA's new heavy-lift rocket capable of sending the agency's Orion spacecraft beyond low-Earth orbit to destinations such as Mars.

"During my time at NASA, I hope to learn the methods to bring an incredibly complex piece of equipment such as the (SLS) solid rocket booster to materialization," he said. "This will be useful in any industry where safe and high-quality final products are desired."

Divine Onyemize's goal is to learn about the different career paths and opportunities available at Kennedy. A sophomore mechanical engineering major at North Carolina Agricultural and Technical State University in Greensboro, North Carolina, Onyemize is working in the center's Spaceport Integrations and Services Directorate.

"Networking is extremely important to me," Onyemize said. "There are so many people here that are doing really cool things. I hope to do their kind of work. Getting to interact with them is truly exciting!"

Students interested in NASA's NIFS program can learn more by applying through its One Stop Shopping Initiative.

[Read more about the process here.](#)

For more photographs of interns at work at NASA's Kennedy Space Center, check out the [NASA Internship Program Flickr album.](#)



From the left, Jeremiah House, Thomas Muller and Austin Langdon are at work in the Swamp Works laboratory at Kennedy Space Center. According to House, "I am hoping and fully expecting to learn about the teamwork dynamic present in most, if not all, areas of engineering." House is studying computer/electrical engineering at John Brown University in Siloam Springs, Arkansas. Muller is pursuing a degree in computer engineering and control systems at Florida Tech. Langdon is an electrical engineering major at the University of Kentucky. Photo credit: NASA/Bill White



In the Swamp Works laboratory at Kennedy Space Center, student interns such as Kevin Murphy are joining agency scientists, contributing in the area of Exploration Research and Technology. He is majoring in mechanical engineering at the University of Illinois at Urbana-Champaign. Photo credit: NASA/Bill White



Student intern Ayla Grandpre is a senior majoring in computer science and chemistry at Rocky Mountain College in Billings, Montana. This summer she is studying potential space crops and ways to pollinate flowers in space, which will give astronauts the option to grow fruit. Photo credit: NASA/Bill White



First Nations Launch winners visit Kennedy Space Center

BY BOB GRANATH

A group of 15 college students recently visited NASA's Kennedy Space Center as winners of the First Nations Launch competition in Wisconsin. They were part of teams that successfully flew high-powered rockets, earning them an opportunity to visit the Florida spaceport.

The competition is supported by NASA and the Wisconsin Space Grant Consortium. It provides an opportunity for students attending tribal colleges and universities or who are members of a campus American Indian Science and Engineering Society, or AISES, chapter to design, build and launch a rocket at a competition in Kansasville, Wisconsin.

"The project has been ongoing for nine years," said Rob Cannon, a project specialist in Kennedy's Education Office who serves as activity manager for the visit of the First Nations Launch Competition. "NASA began supporting it starting with the second year."

During the students' visit to Kennedy, they toured the Vehicle Assembly Building, Launch Control Center, Swamp Works, Kennedy Prototype Shop, Cryogenics Lab and the visitor complex. They also were given the opportunity to participate in a panel discussion on career opportunities with NASA, contractors or other areas of the aerospace industry.

Christian Cultee participated as a student at Northwest Indian College established by the Lummi Nation in Bellingham, Washington. He noted that his visit was one he would not soon forget.

"Every stop of our tour made me even more eager to see where they would bring us next," he said. "We extend our appreciation to the employees who took time out of their busy schedules to share with us their experience at Kennedy. We would like them to know that their impact on us was much larger than they'll ever know."

While competitors usually are majoring in engineering disciplines, Cannon noted that that's not always the case.

"There was one team that was made up entirely of nursing students," he said. "While it may help to be majoring in a technical field, the competition is open to any student interested in building a rocket and is attending a tribal college or a member of an AISES chapter."

There are two annual challenges students may choose to enter. In this year's Tribal Challenge, a rocket is launched and is judged on its stability using a small onboard camera. In the AISES Challenge, student teams from AISES chapters design, build and launch a rocket that will be able to provide an active drag system integrated into the rocket by means of a mechanical device. The goal is to attain an altitude of exactly 75 percent of the nondeployed drag system to the altitude of the first launch.

HACKERS UNITE

Space Apps challengers tour Kennedy's innovative labs

BY AMANDA GRIFFIN

A diverse group of college students, entrepreneurs, schoolteachers and even a 13-year-old were treated to a behind-the-scenes tour of some of NASA Kennedy Space Center's most innovative labs on July 28. Kennedy's Spaceport Planning office invited the group, which represented more than 15 previous participants, organizers and sponsors of the International Space Apps Challenge.

Space Apps is a mass collaboration focused on space exploration that takes place over 48 hours in 160+ cities around the world, with a goal of producing relevant open-source solutions to address global needs applicable to life both on Earth and in space.

"We are bringing together innovators in the Orlando and local community to meet the innovators in our Kennedy Space Center community," said Caley Burke, an engineer with the spaceport's Launch Services Program and Kennedy's Space Apps project lead. "It gives them an opportunity to see the work that we are doing here at Kennedy — our new and exciting projects — and how we get business done."

"With our transformation to a multi-user spaceport, the Spaceport Planning Office has been pushing to strengthen ties between Kennedy, the Orlando High Tech Corridor and Orlando Inc.," said Kennedy Master Planner Trey Carlson. "Working with the executive director of Orlando Inc. to schedule this visit with Caley and other spaceport innovators just made sense."

For the participants, it's a chance to get an inside peek at how the space center works.

Holly Akers is an event planner who began helping plan Orlando's Space Apps Challenge event two years ago. "They give out these challenges, and they are real problems that NASA scientists actually face," she said. "Most people tend to think, 'It's NASA, it's out of my league,' but it might not be!"

This message resonated with Jacob Waag when he participated in his first challenge two years ago at age 12. According to Jacob, his mom, Mary Waag, dragged him into it — but don't let him fool you. He is hooked.

Akers, a mother of a teen herself, thinks people underestimate kids, and that Jacob is a perfect example. "If you give them the



Jacob Waag, a middle school student from Sanford, Florida, was one of the International Space Apps Challenge participants to receive a behind-the-scenes tour of Kennedy Space Center earlier this year. Photo credit: NASA

environment and the resources, they will do amazing things."

Even though Jacob initially joined because his mom just wanted to get him out of his room and away from his computer games, he was actually part of one of the winning teams his first year.

"I just like being around all the technological people that are like me and like technology," Jacob said. "And I can learn from them. Me, being 13, I don't know that much about technology. I've learned how to code because of this."



International Space Apps Challenge participants from Orlando gather outside the Swamp Works Laboratory during a tour of Kennedy Space Center in Florida. Photo credit: NASA

Jacob plans to continue participating in the challenge, and he hopes this experience will help him get into a good college where he can study to become a penetration tester, which, according to Jacob, is "hacking for the good guys" — a way to show the weaknesses of people's systems so they can bolster them.

The benefit for the Kennedy participants, according to Burke, is they get a chance to understand what is going on in the community outside of the center. "We can be a little insular sometimes," she said. "By hearing from people outside of our business, we can get new ideas and potentially foster relationships that might lead to working with new companies we haven't considered before."

Valerie Cepero was one of the visitors to the spaceport and is an Orlando native who met Burke after a mutual friend introduced the two. "I've always been passionate about showing what a vibrant community Orlando is," Cepero said. She believes that events like this challenge attract people to the area, showing it is an innovative place to live and work.

The next **International Space Apps Challenge** will be in spring of 2018. The next hackathon that the Kennedy Space Apps team will be supporting is a space game developing weekend, the **Indie Galactic Space Jam**, in Orlando, Sept. 29-30, 2017.



From the Kennedy Space Center Visitor Complex, guests joined Americans from coast to coast following the solar eclipse. Although a partial eclipse on Florida's Space Coast, young and old alike found many ways to watch the rare astronomical event Aug. 21, 2017. As the Moon passed between Earth and the midafternoon Sun, a shadow moved across the landscape. The 70-mile-wide totality path, or "umbral cone" -- where the entire Sun vanished behind the Moon -- stretched across 14 states, from Oregon to South Carolina. Photo credit: NASA/Ben Smegelsky

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