November 2015 Vol. 2 No. 11

National Aeronautics and
Space Administration

KENNEDY SPACE CENTER'S

SPACEPORT magazine

15 Years Aboard the ISS

Aeronautics Research | Mars | Technology | Earth Right Now | ISS | Solar System & Beyond

KENNEDY SPACE CENTER'S

SPACEPORT MAGAZINE

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Front Cover: Astronaut Chris Cassidy, Expedition 36 flight engineer, is shown floating in front of the Cupola windows For more about the International Space Station, go to **http://go.nasa.gov/9cE4DW**. Photo credit: NASA

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KSC BLOG

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NASA'S LAUNCH SCHEDULE

Date: Nov. 21
Mission: Progress 62P Cargo Craft
Description: The Progress resupply vehicle is an automated, unpiloted version of the Soyuz spacecraft that is used to bring supplies and fuel to the International Space Station, or ISS.

Targeted Date: Dec. 3, 6 p.m. EST
Mission: Fourth Orbital ATK Commercial Resupply Services Flight to ISS
Description: The mission will be the first flight of the enhanced variant of Orbital ATK's Cygnus advanced maneuvering spacecraft, capable of delivering more than 7,700 pounds of essential crew supplies, equipment and scientific experiments to the station. The Atlas V will launch from Cape Canaveral Air Force Station in Florida during a 30-minute window.

Date: Dec. 15
Mission: Expedition 46 Launch to the ISS
Description: NASA astronaut Tim Kopra, ESA astronaut Tim Peake and Yuri Malenchenko of Roscosmos will launch to the ISS aboard a Soyuz spacecraft from the Baikonur Cosmodrome, Kazakhstan.

Date: March 2016
Mission: InSight (Interior Exploration Using Seismic Investigations, Geodesy and Heat Transport)
Description: The mission will study the deep interior of Mars to advance understanding of the early history of all rocky planets, including Earth.

I am KENNEDY SPACE CENTER

ANIBAL KARBAN

Working for NASA more than 12 years, I have been able to take part in several of my dream jobs.

I started as a rocket scientist "propulsion engineer" for the Launch Services Program, or LSP. My most exciting and challenging responsibility was to provide the go or no-go assessment for the Delta II propulsion systems during launch.

Looking for new challenges, I was given the opportunity to work in the LSP Business Office where I supported the Flight Projects Support Branch and the Program Support Branch for almost two years. There I obtained a strong business foundation for my next opportunity with the NASA Engineering Mechanical Division. I worked as a technical assistant to the division chief for five years. This opportunity permitted me to learn how our management make the decisions that allow the engineering experts to come together to make NASA's mission a success.

Currently, I serve as the project activation support lead for Ground Systems Development and Operations, or GSDO. I am responsible for providing leadership and technical expertise to the elements in the development and execution of an activation plan that will support the GSDO goals of a timely readiness for the Space Launch System, or SLS, operations ready date. The most exciting part of my job is knowing that I am part of the team that is working to make the SLS and the U.S. space program a success.

I also am the education lead of one of the employee resource groups at Kennedy. The Hispanic Outreach and Leadership Alliance, or HOLA, has been a passion of mine for the past seven years. I am honored to have the opportunity to encourage and inspire other employees to achieve their highest capability. I feel privileged to be part of the NASA family!

Anibal

Firefly
Alpha 1.0

Rocket Lab
Electron

BOARDING PASS

VENTURE CLASS

TICKET TO RIDE

Flights begin departing 2017

CubeSat launchers expected to open research opportunities

BY STEVEN SICELOFF

NASA opened a new avenue for exploration and technology development with awards to three companies to launch missions dedicated to CubeSats. The tiny, box-shaped spacecraft have emerged in the last 16 years as a quick, viable way to test components and techniques that, if proven, can be applied to much larger missions where the stakes are far greater than a simple, 4-inch cube. With these new Venture Class Launch Services, or VCLS, contracts, the price tag for each mission is one-tenth the cost of the least-expensive traditional launcher.

Proposals were accepted from Firefly Space Systems, Rocket Lab USA and Virgin Galactic to conduct demonstration CubeSat launches as soon as 2017. The first phase of launches are expected to be completed by the end of calendar year 2018. The total value of the three contracts is $17.15 million, with $6.95 million awarded to Rocket Lab, $5.5 million to Firefly Space Systems and $4.7 million to Virgin Galactic. NASA officials anticipate more Venture Class launches to serve SmallSats in the future.

"Emerging small launch vehicles have great potential to expand the use of small satellites as integral components of NASA's Earth science orbital portfolio," said Michael Freilich, director of NASA's Earth Science Division. "Today's CubeSat technology fosters hands-on engineering and flight research training; with the addition of reliable, affordable, and dedicated access to space on small launchers, constellations of SmallSats and CubeSats could revolutionize our science-based spaceborne Earth-observing systems and capabilities. We're eager to work with the VCLS providers as they develop new launch capabilities for the Earth science community."

Many of the CubeSat missions undertaken so far have related to Earth observation with instruments focused on a single element of research such as resource management. That focus is expected to remain in the future as scientists and engineers produce ever-more-capable spacecraft that can quickly deliver technological advances to Earth science arenas.

"The award of these contracts represents NASA's investment in the future of the commercial launch industry for SmallSats," said Mark Wiese, chief of the Flight Projects Office for NASA's Launch Services Program, or LSP, based at Kennedy Space Center. "Although the three launch vehicles are new in aerospace, their designs are advanced sufficiently that we feel comfortable relying on them for these missions. The companies have also received interest from other non-NASA customers in using their launch services, leveraging private investment for their development costs, tied to their vision to serve a viable commercial data market."

The Earth Science Division of NASA's Science Mission Directorate in Washington has partnered with LSP to fund the VCLS contracts. These VCLS launches of small satellites are able to tolerate a higher level of risk than larger missions and will demonstrate, and help mitigate risks associated with, the use of small launch vehicles providing dedicated access to space for future small spacecraft and missions.

"Director Freilich's sponsorship was essential to enabling this class of launch vehicle to become available in the near future," said Jim Norman, director of LSP. "This type of support will allow the U.S. commercial space launch industry to be early to market with this new capability and bodes well for the future."

Without a dedicated launcher, at present, the backlog of 50 CubeSats essentially have to rideshare and fly standby. Up until now, they also had to fly into orbit as auxiliary payloads that are released after the booster has achieved the primary mission. They have also been sprung into the orbital void from canisters aboard the International Space Station to conduct research missions. In both cases though, the CubeSats are at the mercy of the primary payload and the orbit it must fly in.

That's why NASA solicited the private launch industry for rockets that could carry potentially dozens of CubeSats into space, resulting in dedicated launch costs much lower than available now for primary missions. As it did with contracts to take cargo to the space station on private rockets, NASA sought to buy a service rather than develop its own new launch system. A single launch will be able to carry 15 to 30 CubeSats.

"The CubeSat and small satellite engineers and scientists are coming up with missions that justify flying unique orbits and at altitudes that are not available if we only fly as secondary payloads," said Garrett Skrobot, lead for the Educational Launch of Nanosatellites, or ELaNa, mission for LSP. "These are still experimental satellites, but the technology they are employing is mature enough to use in these new ways."

Two of the companies are considering launch options from Kennedy's spaceport. Firefly Space System's Alpha vehicle and Rocket Lab's Electron vehicle can be launched from a number of locations. Virgin Galactic expects to launch from its base at Mojave, California, but it has the ability to launch from anywhere in the world.

"CubeSats give us a much faster way to test technologies and move their designs up the readiness ladder," Skrobot said. "Even if they don't succeed the first time, a re-flight is not prohibitively costly and designers can apply new components or processes quickly."

The advent of small satellite capabilities is expected to increase quickly in the United States and internationally, along with the opportunities foreseen by entrepreneurs to launch CubeSat-based networks that can transmit to anywhere in the world, monitor crops in detail and improve weather forecasting.

"The award of these contracts represents NASA's investment in the future of the commercial launch industry for SmallSats."

Mark Wiese
Chief of the Flight Projects Office,
Launch Services Program

Learn more about how space enthusiasts can propose a mission through the CubeSat Launch Initiative through the current opportunity announcement online at **http://go.nasa.gov/1GGnDpN**

BIG THINGS COME IN SMALL PACKAGES

PhoneSat 2.5, developed at NASA's Ames Research Center in Moffett Field, California and launched in March 2014, uses commercially available smartphone technology to collect data on the long-term performance of consumer technologies used in spacecraft. Photo credit: NASA

Measuring about the size of a coffee mug and weighing about three pounds, CubeSats carry experimental components and are inexpensive and modular enough to be built by enterprising university and high school groups, technology companies and NASA researchers. The inventions and results from missions flown in Earth orbit have advanced to the point that NASA is dispatching a pair of CubeSats to Mars along with the InSight lander. The CubeSats, each built in a modular format by Jet Propulsion Laboratory and the size of a briefcase, will provide a communications relay to ground stations on Earth as Insight approaches the Red Planet and touches down on the surface.

In-Situ Materials Challenge

#publicprizes

Want to build stuff on Mars? The In-Situ Materials Challenge seeks solutions to utilize surface-based materials like regolith (crushed basalt rock) for Earth and space fabrication and construction applications and offers a first-place prize of $10,000 and two second-place prizes of $2,500 for top submissions. **Deadline is Dec. 3, 2015.**

Find out more at: **http://www.nasa.gov/feature/in-situ-regolith-modular-structural-element-system-challenge.**

KSC Scenes

A crane lifts the seventh tier for placement at Space Launch Complex-41 at Cape Canaveral Air Force Station in Florida, to form the Crew Access Tower under construction by Boeing and United Launch Alliance.

As with the previous tiers, the seventh element of the tower was built at a construction yard 4 miles south of the launch pad.

Once completed, the Crew Access Tower will stand 200 feet tall and offer access to the Boeing CST-100 Starliner spacecraft by astronauts, flight crews and ground support teams at the launch pad. The Starliner is under development in partnership with NASA's Commercial Crew Program.

Photo credit: NASA/Jim Grossmann

INTERNATIONAL SPACE STATION
OFF THE EARTH FOR THE EARTH

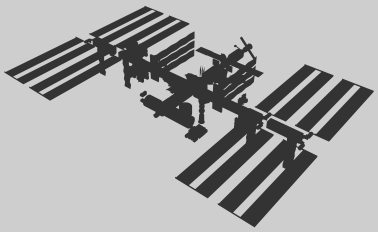
INTERNATIONAL SPACE STATION 1

45 Crewed Expeditions...so far

November 2, 2000

Expedition 1:
William Shepherd
Sergei Krikalev
Yuri Gidzenko

First Crew Docking



{ 32,333 cubic feet of volume }

The **International Space Station** weighs **930,000 pounds** and has the same pressurized volume as a **Boeing 747**, providing more livable room than a conventional **six bedroom house**.

More than **1,200 scientific results publications** have been produced.

There have been more than **180 U.S. and Russian spacewalks.**

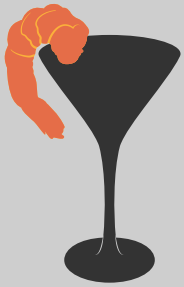
The Space Station is an international endeavor of global collaboration, with more than **220 people from 17 countries** visiting the ISS since 2000.

The Space Station program involves more than **100,000 people** in space agencies and at **500 contractor facilities** across **37 U.S. states and in 16 countries**. That's one sixth the population of Vermont.

For a vertical jpeg of this image, go to http://go.nasa.gov/1GZiY2k

5th ANNIVERSARY Human Habitation

Space Station educational activities on orbit have reached more than **42 million students** across the globe.

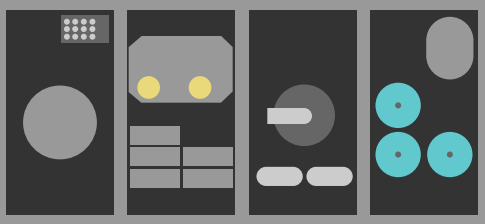


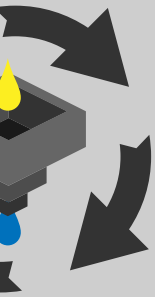
Crews have eaten more than **26,500 meals** since Expedition 1. Approximately **7 tons of supplies** are required to support a crew of three for about **6 months**. Some crew favorites include shrimp cocktail, tortillas, and macaroni and cheese.

The first research study was **protein crystal growth**, happening before humans lived there. The study of protein crystals in space is **helping treat diseases and disorders on Earth**, such as Duchenne Muscular Dystrophy.

20 objects with 13 different designs, including a ratchet wrench, have been printed by a **3-D printer** aboard the Space Station.

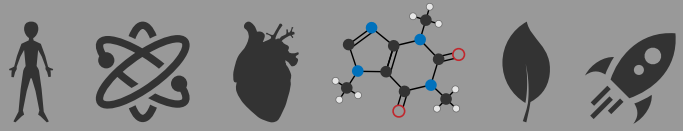
29 research racks, about the size of a refrigerator, enable important research aboard the Space Station. This includes 15 attached external payloads.

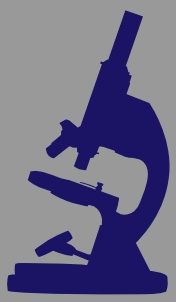




The Water Recovery System reduces crew dependence on cargo resupply of water by 65% - **from about 1 gallon a day to .34 gallon**. This is just one of many ways the International Space Station serves as a stepping-stone to deeper space exploration.

More than **1,760 research investigations** from researchers in more than **83 countries** and areas have been conducted to date on the orbiting laboratory.





22 scientific investigations were conducted during Expedition 1. **191 investigations** will be conducted during Expeditions 45 and 46.

Top 10

Ways ISS is helping get us to Mars

BY RACHEL HOBSON

The International Space Station is paving our way to Mars as the only microgravity laboratory in which long-duration investigations can take place. From understanding how the human body reacts to long-term spaceflight to testing critical systems for Mars missions, the space station is a crucial stepping stone to deep-space exploration.

Here are the top 10 ways the space station is helping us on our Journey to Mars:

10. Understanding Communications Delays

You may get frustrated when a text takes more than a second or two to send, but crews heading to Mars will have to deal with extensive communications delays during their journey to and from, and while on the Red Planet. Comm Delay Assessment studies the effects of delayed communications for interplanetary crews that have to handle medical and other emergencies in deep space. In addition to time delays, uncertainty in performing a new, crucial task can affect crew performance and interaction.

9. Understanding Astronaut Functional Performance

Do you feel a bit clumsy when you first get out of bed in the morning? Imagine how you might feel after spending six months to a year in microgravity! When current space station astronauts return to Earth, a team of medical professionals assess them and begin treatment for any changes in balance and coordination. Crews going to Mars won't have access to such extensive resources, nor much time to recover from the effects of long-duration spaceflight once they land on the Red Planet. The Field Test investigation is working to understand the extent of the physical changes in astronauts who live in space for long periods of time, with an aim toward improving recovery time and developing injury prevention methods for future missions.

8. Understanding Psychological Impacts of Isolation and Confinement

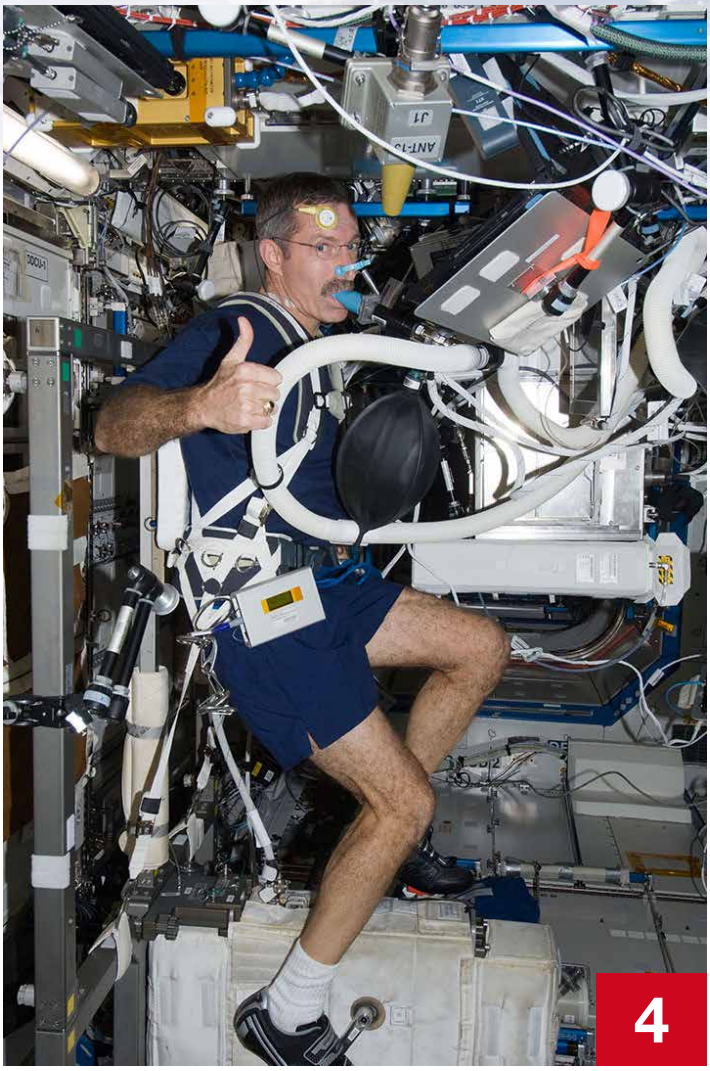
Researchers evaluate the personal journals, totaling nearly 285,000 words — essentially a 1,100-page book of data, of ISS crew members for a wide range of emotional and psychological states and create a rank-ordering of behavioral observations. These journals obtain information on behavioral and human issues that are relevant to the design of equipment and procedures and sustained human performance during extended-duration missions. Study results provide information to help prepare for future missions to low-Earth orbit and beyond.

7. Understanding how astronauts' vision is affected by long-duration spaceflight

One of the most valuable tools astronauts have for gathering information during a mission on Mars is their own set of eyes. Long duration spaceflight, though, can often cause changes to crew members' vision. The Ocular Health study monitors microgravity-induced visual impairment, as well as changes believed to arise from elevated intracranial pressure, to characterize how living in microgravity can affect the visual, vascular and central nervous systems.

6. Understanding immune responses after long-duration missions

Midcentury science fiction often told crazy stories of mutant alien microbes that would infect humans, causing all kinds of mayhem. Reality isn't quite so dire, but scientists do need to understand how long-duration spaceflight affects the way crew members' bodies defend against pathogens. The Integrated Immune investigation will assess the clinical risks resulting from the adverse effects of spaceflight on the human immune system, and will validate a flight-compatible immune monitoring strategy. To monitor changes in the immune system, researchers collect and analyze blood, urine and saliva samples from crew members before, during and after spaceflight.



4. Understanding what kind of exercise is needed for long-duration missions

Having trouble staying motivated during your morning workout? Just pretend you are trying to stay in shape for your mission to Mars! Rigorous exercise is already a regular part of astronauts' routines, and continuing that focus will be critical to keeping crew members' bodies strong and ready for a mission to Mars and a healthy return to Earth. The Sprint investigation is studying a shift in the intensity and duration of current astronaut exercise regimens to determine if higher intensity resistance exercises and interval aerobic exercise would help to maintain physiological function while simultaneously decreasing total exercise time and volume.

3. Understanding what the best habitat/environment for the crews will be

"Home sweet home" takes on an entirely new meaning when you are living in cramped quarters with an entire crew for months on a Mars mission. Cabin designs must balance comfort and efficiency. The Assessment of International Space Station Vehicle Habitability collects observations about the relationship between crew members and their environment on the International Space Station. Observations can help spacecraft designers understand how much habitable volume is required, and whether a mission's duration impacts how much space crew members need.

5. Understanding what types of foods will be best for long-duration crews

When you head out for a long hike, packing the foods that will give you the most energy for the longest amount of time is key to the success of your hike. The same is true for astronauts on long-duration missions. The Energy investigation measures an astronaut's energy requirements for long-term spaceflight, which is a crucial factor needed for sending the correct amount of the right types of food with space crews.

2. Understanding how to best grow food in space

Fresh food for astronauts on long-duration missions will provide valuable nutrition, as well as offer psychological benefits from tending and harvesting the crops. The Veggie investigation is studying how to best utilize a facility aboard the orbiting laboratory for growing fresh produce in microgravity. Astronauts aboard the space station recently harvested and ate space-grown lettuce for the first time. This kind of "astro farming" will be a critical component of Mars missions.

1. Understanding how to manufacture items in space

As crews head to Mars, there may be items that are unanticipated or that break during the mission. Having the ability to manufacture new objects on demand while in space will greatly benefit missions. The 3-D Printing in Zero-G Technology Demonstration validates that a 3-D printer works normally in space. This is the first step towards establishing an on-demand machine shop in space, which is a critical enabling component for crewed missions to deep space.

15 Years of Work

Kennedy's leader reminisces about laying foundation of space station

BY BOB GRANATH

NASA and its partners around the world are celebrating the 15th anniversary of ongoing work aboard the International Space Station, or ISS. Kennedy Space Center Director Bob Cabana, who commanded the flight that began assembly of the orbiting laboratory, is proud of the Florida spaceport team that helped make it possible.

"One of the things Kennedy does better than anyone else in the world is processing, launching and recovering spacecraft," he said. "The team here performed phenomenally on preparing elements of the International Space Station. The people here now are continuing that great work, supporting resupply missions to the ISS."

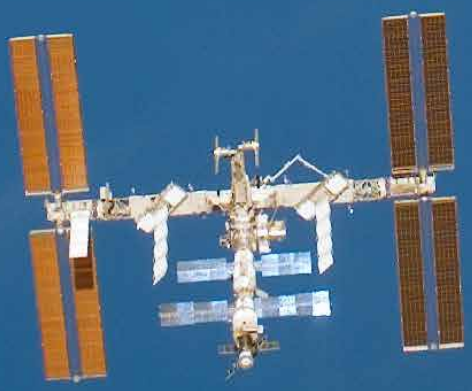
After the first space station element, "Zarya," was placed in orbit by Russia, Cabana's crew of the space shuttle Endeavour lifted off from Kennedy on Dec. 4, 1998. They carried the first American-launched element, node 1, called "Unity." The 12-day, STS-88 shuttle flight was highlighted by connecting Unity to Zarya.

"It was really special when we got to go inside the space station the first time," Cabana said. "We opened the hatch, turned on the lights and began the work of activating this magnificent, orbiting laboratory."

Following the addition of other ISS elements, permanent occupancy began Nov. 2, 2000, when the Expedition 1 crew docked with the station. American astronaut Bill Shepherd, along with Russian cosmonauts Yuri Gidzenko and Krikalev moved in and began activation of the space station and scientific research that has continued nonstop for 15 years.

Looking back, Cabana believes a key to the station's success is people from many nations working together.

"When it came time to actually go through the hatch, I waved (Russian cosmonaut) Sergei (Krikalev) up and opened the hatch and the two of us went in side by side — a Russian and an American into a space station," Cabana said. "It was an International Space Station and international crew."



◄ Astronaut Frederick Sturckow,STS-88 pilot, and Robert Cabana, mission commander, are photographed on the orbiter Endeavour's aft flight deck. Photo credit: NASA

In addition to the United States and Russia, ISS participating nations are Japan, Canada, and the 11 members of the European Space Agency — Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom.

"We continue to learn," Cabana said. "Now Scott Kelly and Mikhail Korniyenko are up on the space station for a year. We still have a lot to discover about human physiology in extended periods of time in microgravity."

Launched to the ISS on March 27 earlier this year, astronaut Kelly and cosmonaut Korniyenko are planning to double the usual six-month stay on orbit.

"Our ultimate goal is to get to Mars," Cabana said.

The role of the International Space Station includes serving as an engineering analysis platform for innovative technology required to travel the 49 million miles to the Red Planet, land, explore and return to Earth. The station is aiding scientists and engineers designing vehicles such as NASA's Space Launch System rocket and Orion spacecraft which will expand human presence in deep space and enable exploration of new destinations in the solar system.

"The systems we need to make that happen have to be extremely reliable," Cabana said. "Having the station up there is a phenomenal engineering test bed helping us prove the design of systems for the Space Launch System and Orion to explore beyond Earth."

Top: Working together inside the American built "Unity" module on Dec. 10, 1998, STS-88 mission commander Bob Cabana and Russian cosmonaut Sergei Krikalev prepare to open the hatch to the Russian assembled "Zarya" module. Photo credit: NASA

Middle: Commander Robert Cabana sets up the camera in the middeck with help from Mission Specialist Nancy Currie. Photo credit: NASA

Bottom: STS-88 commander Robert Cabana is photographed on the Endeavour's middeck with various bags of candy. Photo credit: NASA

Commercia

Astronauts Bob Behnken and S
with Tabatha Thompson from N
to answer questions subm
#askNASA Monday, Oct. 19
Washington, D.C. Behnken and
Boe and Doug Hurley, were s
Boeing and SpaceX as the com
Crew Program develop the CST
for missions into orbit. They spo
helping develop the next genera
that will fly astronauts to the
Here is a sample o

ISS

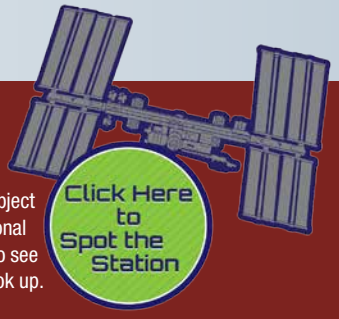
Q: You were the former chief of the astronaut office, so what sort of traits would you look for when you're recruiting a new class of astronauts?

A: I would say that there's really been a shift over the decades and we really are going into a new direction with Commercial Crew. There was a time when every astronaut was a test pilot, a military officer who had graduated from one of the test pilot schools and that's getting further and further into the past. The Commercial Crew vehicles, we expect those to be operated by people who don't necessarily have a military test piloting sort of a background. That's one of the responsibilities that's on the plate of Suni, myself and the two other folks that are assigned — Doug and Eric — to make sure that we produce a vehicle that a wide range of people will be able to take to the International Space Station.

You can read a recap at http://go.nasa.gov/1NRgSEb.
You also can watch the video replay at https://youtu.be/OlugY_yg1HE.

l Crew Q&A

As the third brightest object in the sky the International Space Station is easy to see if you know when to look up.



Sunita "Suni" Wiliams sat down ASA's Office of Communication itted on social media using from NASA Headquarters in d Williams, plus astronauts Eric selected to work closely with panies and NASA's Commercial -100 Starliner and Crew Dragon ke about the work involved with ation of human-rated spacecraft International Space Station. f the conversation.

Q: We're talking about these two vehicles and before we came in here today we were talking about why it's such an exciting time with all of these vehicles in development. Could you explain why that's so significant at this point?

A: This is the first time in Bob's and my career that we've actually had a new spacecraft. Both of us have flown in space but on the space shuttle and the Russian Soyuz and both of those had been developed and we jumped into the training program to fly those spacecraft. This is where we're actually being part of the process as these spacecraft are being developed so we're involved with both the ones that are being developed for Commercial Crew and this is also allowing NASA to focus their attention on developing Orion, so right now, even though it seems a little quiet at the Kennedy Spaceport, it's ramping up to be pretty busy in the near future and we're going to have to integrate all these different spacecraft into the traffic model going up to the International Space Station. It's really busy. We've got this International Space Station program that's going on, we've got this commercial program that's ramping up rather rapidly and we've got this development of Orion that's coming up so people are working really hard all throughout the country to get all of these space systems going.

More than 50 high school and college students skipped school Oct. 29 to shadow employees at Kennedy Space Center.

As part of Disability Mentoring Day, or DMD, students were able to learn first-hand, what it is like to work at NASA.

The students are shown here sitting on console inside the Mission Director's Center inside Hangar AE at Cape Canaveral Air Force Station in Florida.

Students were paired with mentors across the center based on their career interests. DMD promotes career development for students and job-seekers with disabilities through hands-on career exploration and ongoing mentoring relationships.

Photo credit:
NASA/Ben Smegelsky

Attendees speak to exhibitors during the 25th Kennedy Space Center Business Opportunities Expo 2015 at Cruise Terminal 10 at Port Canaveral. The event featured about 150 businesses, large and small, and government exhibitors from throughout the Space Coast and the nation. The Business Expo is sponsored by the NASA/KSC Prime Contractor Board, 45th Space Wing and Canaveral Port Authority. Exhibitors included vendors from a variety of product and service areas, such as computer technology, engineering services, communication equipment and services, and construction and safety products, to name a few. Representatives from the 45th Space Wing, KSC prime contractors, NASA and many more agencies and organizations were on hand to provide information and answer questions.

Photo credit: NASA/Kim Shiflett

HISTORI

Members of the 332nd Fighter Wing. Photo courtesy of The Tuskegee Airmen National Historical Museum.

"The first section of the wreck we documented were the wings… As we removed algae, the signature military star became apparent. This sight almost brought tears to my eyes underwater. At this point, I recognized the ultimate sacrifice Lt. Moody and many other Tuskegee Airmen paid for their beliefs and their country."

Erik Denson
NASA Engineer

CAL DIVE

NASA engineer helps preserve legacy of Tuskegee Airmen

BY BOB GRANATH

During a week this past summer, a group of underwater explorers embarked on a mission to preserve part of America's heritage. According to team member and NASA engineer Erik Denson, it was a "mission of a lifetime."

On Veterans Day, Nov. 11, Americans will pause to honor those who have served in the nation's military services. Meanwhile, Denson and a small team of underwater divers spent some time in August helping maintain the history of the Tuskegee Airmen.

Formally organized as the 332nd Fighter Wing and the 477th Bombardment Group of the U.S. Army Air Force, the Tuskegee Airmen were the first African-American fighter and bomber pilots. The group also included the navigators, bombardiers, mechanics, instructors, crew chiefs, nurses, cooks and others who supported the airmen. The military pilots trained at Moton Field near Tuskegee, Alabama.

"During World War II, Michigan was home to several African-American air combat units including many graduates of the Tuskegee pilot training program," Denson said. "Army Air Force pilots were simulating aerial combat and bombing exercises over Lake Huron, as the climate and terrain mimicked what they would see in Europe."

Due to the realistic nature of such war-time simulations, at least seven pilots of the 332nd Fighter Wing tragically lost their lives while training over water near Michigan. Denson noted that a P-39Q Airacobra fighter plane was found last year by a member of the local county sheriff's department. The plane was flown by 2nd Lt.

An experienced archeological diver, Erik Denson checks out a machine gun that was part of a P-39 aircraft that crashed during a training exercise in Lake Huron off the coast of Michigan on April 11, 1944. Photo courtesy: Erik Denson

Frank Moody, a Tuskegee pilot from Castle, Oklahoma. Moody was killed in the 1944 crash. While his body was quickly recovered, the aircraft was lost.

The plane was found in 30 feet of water at the lower end of Lake Huron north of the city of Port Huron, Michigan. Ironically, the aircraft was discovered April 11, 2014, 70 years to the day after the accident.

When NOAA — the National Oceanographic and Atmospheric Administration — issued a request for certified underwater archeologists to survey the site, Denson was quick to volunteer. NOAA is responsible for such expeditions as they provide the principal investigators for studying underwater formations and sunken relics.

"I have drawn inspiration from pioneers of aeronautics such as the Tuskegee Airmen," Denson said. "So, combining an archeology expedition to study one of their aircraft with my life-long passion for diving was an opportunity I couldn't pass up."

While growing up on Long Island, New York, Denson watched Apollo astronauts walk on the moon and a career in aeronautics and space exploration soon became his goal.

"I decided in high school to become an engineer and work in the space program," he said.

Denson received a bachelor's degree in electrical engineering from Howard University in Washington. He went on to earn a master's in electrical engineering at Polytechnic University in Brooklyn, New York, now the School of Engineering of New York University.

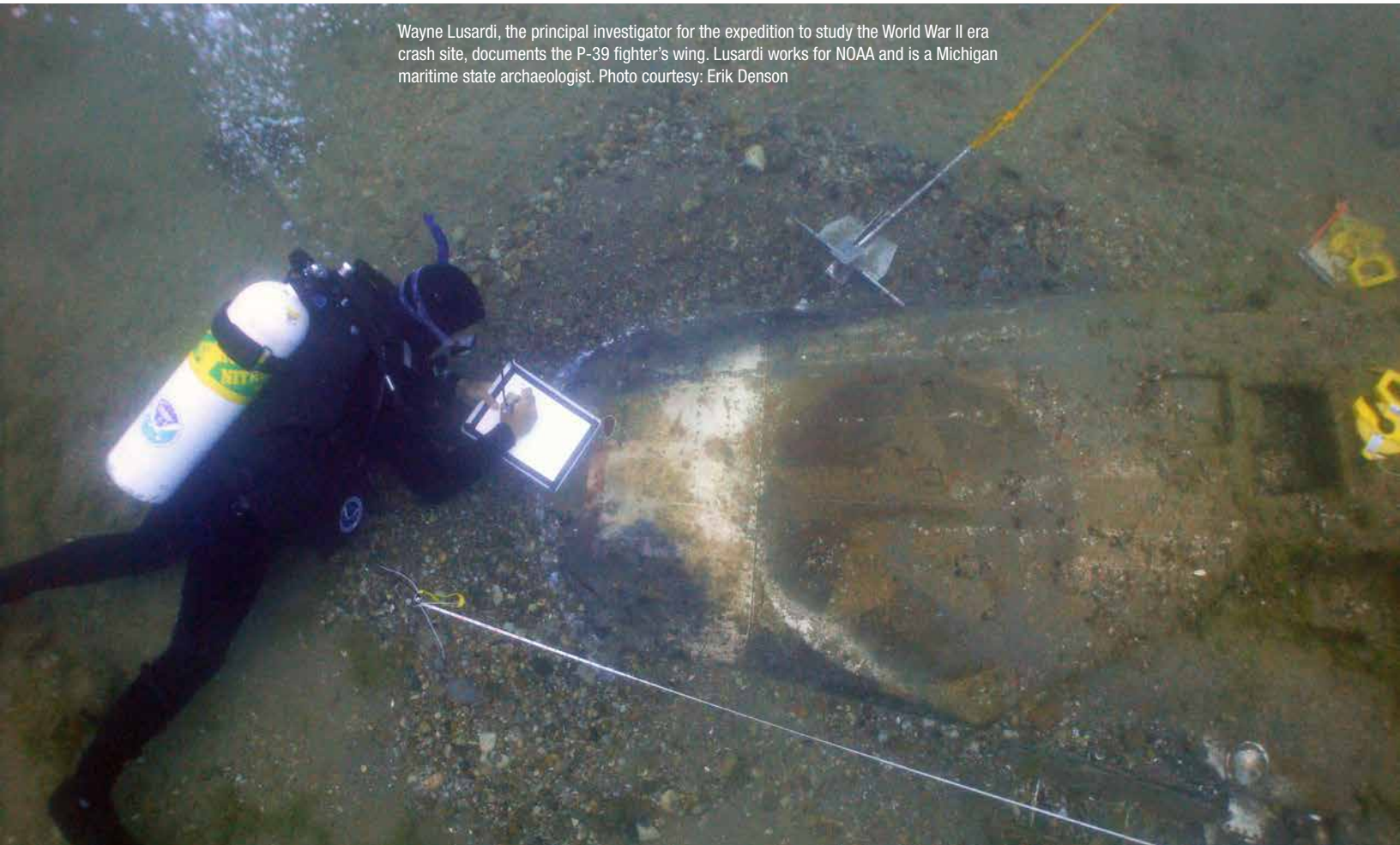
Denson achieved his dream of working for NASA 25 years ago and now is Kennedy's electrical chief engineer in the spaceport's Engineering Directorate. Over the years, Denson has worked on projects such as the Operational Intercom System and STARS — the Space-based Telemetry and Range Safety system. He also is currently overseeing the design and development of ground support equipment for the Space Launch System and Orion programs.

Denson's interest in underwater research stems from his membership in the Diving With a Purpose, or DWP, Maritime Archaeology Program.

"Diving With a Purpose is a community-focused nonprofit, international organization dedicated to the conservation and protection of submerged heritage resources," he said. "The organization's activities provide opportunities for education, training, mission leadership, certification, and field experience to adults and youth in the fields of maritime archaeology and ocean conservation."

In the past, DWP has partnered with the National Park Service to assist in documenting historic shipwrecks in Biscayne National Park, and the slave ship Guerrero. The Spanish vessel sank on a reef near the Florida Keys in 1827.

Between Aug. 9 and 15, 2015, Denson used vacation time to join seven other expert underwater archeologists who surveyed the wreckage of Moody's P-39 fighter aircraft. In addition to Denson, the team included the expedition's principal investigator, Wayne Lusardi of NOAA, a Michigan Maritime State Archaeologist. Also participating were four other divers from



Wayne Lusardi, the principal investigator for the expedition to study the World War II era crash site, documents the P-39 fighter's wing. Lusardi works for NOAA and is a Michigan maritime state archaeologist. Photo courtesy: Erik Denson

At the conclusion of the expedition, Erik Denson holds a wreath the team placed on the waters of Lake Huron above Lt. Frank Moody's crash site. "We cannot let the contributions and legacy of the Tuskegee Airmen fade as time passes," Denson said. Photo courtesy: Erik Denson

DWP and one additional from NOAA.

"Our base of operations was the Port Huron Coast Guard Station," Denson said. "The mission objectives were straight forward and included documenting the aircraft wreckage in its entirety, inventorying and photographing all of the associated aircraft parts, munitions and artifacts."

The Bell Aircraft Corp. P-39 Airacobra was one of the principal American fighter planes in service when the U.S. entered the Second World War. It also was the primary aircraft used by Tuskegee Airmen training over Lake Huron.

Denson explained that the team spent six days diving and documenting the wreck site which was spread over an area of 500 feet. After being submerged for seven decades, the artifacts were covered with algae and mussels. The wings, engine, propeller and tail section were scattered about 100 feet apart.

"The first section of the wreck we documented were the wings," he said. "As we removed algae, the signature military star became apparent. This sight almost brought tears to my eyes underwater. At this point, I recognized the ultimate sacrifice Lt. Moody and many other Tuskegee Airmen paid for their beliefs and their country."

When the pilots of the 332nd Fighter Wing painted the tails of their aircraft red, the nickname "Red Tails" was coined and was chosen as the name of the 2012 motion picture about the Tuskegee Airmen. This aspect of the downed fighter plane being studied by Denson caught his attention.

"I could envision the proud red tail of this Tuskegee Airman's P-39 aircraft flying high," he said. "Seeing the tail of the plane now protruding from the sand 100 feet from the wings was a sobering sight. Then I envisioned the violence of the crash."

Denson explained that a few years ago he had an opportunity to attend a Tuskegee Airmen convention and reunion in Orlando.

"I never ask sports figures or entertainers for autographs," he said. "When I attended the convention, I asked every airman I met for an autograph. They are my heroes."

At the conclusion of the expedition to study the crash site, the team placed a wreath on the waters of Lake Huron above Moody's crash site. They also applied to the National Park Service to have the location added to the National Register of Historic Places.

"We cannot let the contributions and legacy of the Tuskegee Airmen fade as time passes," Denson said.

He explained that he especially appreciated their contributions that provided opportunities for those of future generations, such as himself.

"Lt. Frank Moody and the Tuskegee Airmen sacrificed their lives for their nation and what they believed in even at a time when their nation didn't believe in them," he said. "They opened doors and tore down barriers so we could all pursue our dreams. They are true American heroes."

NASA's Space Launch System, or SLS, will be the most powerful rocket in history for deep-space missions, including to an asteroid and ultimately to Mars. The first flight test of the SLS will feature a configuration for a 70-metric-ton lift capacity and carry an uncrewed Orion spacecraft beyond low-Earth orbit to test the performance of the integrated system. As the SLS evolves, it will provide an unprecedented lift capability of 130 metric tons to enable missions even farther into our solar system.

Image credit: NASA/MSFC

Watch a computer animated simulation of the SLS launching from Kennedy at https://www.youtube.com/watch?v=5MVXAkMeQDc

Check Up

Kennedy Space Center Director Bob Cabana speaks during the kickoff meeting Oct. 6 of the critical design review for the Ground Systems Development and Operations Program at Kennedy Space Center. Photo credit: NASA/Daniel Casper

NASA's Ground Systems Program begins critical design review

BY LINDA HERRIDGE

The NASA program tasked with preparing Kennedy Space Center to process and launch the next generation of rockets and spacecraft kicked off its critical design review Oct. 6. This review is an important milestone for the Ground Systems Development and Operations Program, or GSDO, as it will demonstrate that upgrades to necessary facilities and ground support equipment are on track for the first integrated mission with the agency's Space Launch System, or SLS, rocket and Orion spacecraft.

"We've worked hard the past several years," said Mike Bolger, GSDO program manager, as he welcomed managers and engineers from across the agency to Kennedy. "Seeing the Space Launch System and Orion roll out from the Vehicle Assembly Building is going to be quite a sight, and I'm really looking forward to it."

NASA's three exploration systems development programs — GSDO, SLS and Orion — have been pursuing parallel development paths that keep each program progressing toward the first SLS and Orion mission. Orion will be the safest, most advanced spacecraft ever built. NASA's SLS will be the world's most powerful rocket and will launch astronauts on Orion to explore multiple, deep-space destinations. For its part, GSDO teams specialize in three areas: the first team works to connect a spacecraft with a rocket, move the launch vehicle to the launch pad and send it into space; the second team ensures all processing systems safely prepare a spacecraft for flight; and the third modernizes communications used to launch astronauts into space.

Specifically, the GSDO critical design review will look at the Vehicle Assembly Building, Launch Control Center, mobile launcher, crawler-transporter, Launch Pad 39B and the Multi-Payload Processing Facility. Upgrades and designs currently in progress will be reviewed to ensure they will be ready to support all system and processing requirements for a launch of the SLS rocket and Orion spacecraft.

"When I look at what we've accomplished, and where we are, we are on track and I couldn't be more proud of this team," said Bob Cabana, Kennedy center director.

The design review will continue at Kennedy through December.

National Aeronautics and
Space Administration

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‘From Earth to Mars’

Innovation Expo showcases cutting-edge technologies

BY ANNA HEINEY

If innovation and creativity are the seeds of future technologies, Kennedy Space Center is fertile ground.

New ideas and creativity are central to the spaceport’s transition to a 21st-century launch complex supporting a variety of users as the agency lays the groundwork for the Journey to Mars. At the spaceport’s annual Innovation Expo, held Oct. 15-17, proposals for advanced technologies took center stage as NASA and contractor employees shared their projects and ideas.

Now in its fourth year, the event has grown from a one-day gathering to highlight employee innovations to a three-day showcase.

This year’s Innovation Expo theme, “From Earth to Mars,” featured exhibits and presentations for both the public and center employees from astronauts, a planetary physicist and innovation experts. Subjects included innovations in technology, aeronautics, the International Space Station, and plans to explore Mars, the solar system and beyond.

“This is a special place for me. It’s a place where I just feel like anything can happen,” said the event’s keynote speaker, NASA astronaut Cady Coleman, a veteran of two space shuttle flights and a rotation aboard the International Space Station. She currently works in the agency’s Office of the Chief Technologist at NASA Headquarters in Washington.

“It’s an atmosphere that I believe feeds you, and allows you to do things that are extraordinary.”

The first day of the expo was tailored to employees, beginning with the Kennedy Showcase, in which exhibits and representatives from several organizations and programs shared their capabilities and cutting-edge technologies. Center Planning and Development, International Space Apps Challenge, IT Innovations, Ant-inspired Swarmie Robots, KSC Technology Transfer and KSC Balance Zone were among the more than 15 displays on hand for the showcase.

The Innovation Expo’s opening-day lineup also featured the annual KickStart competition, in which Kennedy employees pitched 21 new project concepts. Coleman and several members of Kennedy leadership served as judges, ultimately select-

ing 12 projects to receive up to $5,000 for equipment needed to make the proposals a reality.

Employees had the opportunity to explore some of Kennedy's laboratories, such as Swamp Works, where robots practice mining in test bins filled with simulated regolith; the Prototype Development Lab, which designs and builds ground support equipment and flight hardware; the Space Station Processing Facility high bay, where station components were readied for flight; the Augmented Virtual Reality Lab, where researchers investigate new methods of human-computer interaction; and the Advanced Spaceport Concepts and Technologies Research and Development Lab, which is developing a variety of state-of-the-art innovations.

During the final two days of the Innovation Expo, the event moved to the Kennedy Space Center Visitor Complex, where guests visited exhibits in the Kennedy Showcase and listened to a series of speakers and presentations offering firsthand information on NASA's six programs currently in motion

Kennedy Space Center Associate Director Kelvin Manning tries out a virtual reality experience at the center's 2015 Innovation Expo. Now in its fourth year, the purpose of the Innovation Expo is to help foster innovation and creativity among the Kennedy workforce. The annual event is designed to encourage NASA and contractor employees to continue to present proposals for advanced technologies. Photo credit: NASA/Dan Casper

including: Earth Right Now, Technology, ISS, Aeronautics, Mars, and the Solar System and Beyond.

NASA's Ground Systems Development and Operations Program, Launch Services Program and Commercial Crew Program were joined by NASA Technology, NASA Aeronautics, Chemical and Biological Sciences and many more, giving visitors a comprehensive view of the technological work in progress in preparation for the journey to Mars.

Innovation begins, Coleman said, with taking on challenges and thinking outside the box to find solutions — and creating an environment where collaboration leads to new ideas.

"Thinking in a different direction is hard to do," she acknowledged. "Everyone has their own kind of jigsaw puzzle and I think what helps is to look around and see what people's jigsaw puzzles are, and support them."

Families visiting the Kennedy Space Center Visitor Complex stop by the Sierra Nevada Corporation's booth during the 2015 Innovation Expo. Photo credit: NASA/Ben Smegelsky

PRIZE PROPOSALS

THE 12 PROJECTS AWARDED FUNDING THROUGH KICKSTART

Cryogenic Liquid Air Quantity Sensor
Innovator: Rolando Valdez, NASA KSC Aero Medicine and Occupational Branch

Regolith Vibro-compaction with Surface Sintering
Innovators: Mike Dupuis, NASA KSC Testing and Design Branch and Evan Bell, along with NASA KSC Environmental and Life Support Systems Branch

FOD "CATCH" (Collect-and-Tether Containment Holders) Devices and Training
Innovators: Mark Smith, Katrine Stelges and Martin Wilson of Jacobs Technology, along with Damon Stambolian, NASA KSC Technical Processes and Tools Branch

LPAWS — Lightning Prediction and Warning System
Innovators: Nathan Miles, Red Canyon Software, Inc., and Hector Pagan, NASA KSC Information Technology and Communications Services Project Management Office

Ice House: 3-D Construction using H2O Ice
Innovator: Rob Mueller, NASA Spaceport Systems Branch

Structural Health Monitoring and the Beginning of the "Digital Twin"
Innovator: Matthew Breault, URS Federal Services Inc.

Cryo-Fluid Capacitor
Innovator: Adam Swanger, NASA KSC Cryogenic Propulsion Systems Branch

Expand Balance Initiative with Mini Balance Zones
Innovator: Mary Kirkland, InoMedic Health Applications Inc., and Darcy Miller, NASA KSC Safety and Mission Assurance

Robotic Mining Competition Regolith Bin Rainproof Lid and Dryer System
Innovators: Gabor Tamasy, NASA KSC Structures and Launch Accessories Branch, and Greg Galloway, NASA KSC Flight Technology Branch

Virtual Tablet
Innovator: Bill Little, NASA KSC Computational Sciences Branch

Planetary Lander Egg-Drop Competition
Innovators: Samantha Thorstensen, NASA KSC Education, along with Alex Greutman, Ryan Elliot and Mike Hull, Delaware North Companies Parks and Resorts

UV Cured 3-D Printing using Regolith
Innovators: Tom Lippitt and Rob Mueller, NASA KSC Spaceport Systems Branch

Journey to Mars

NASA is leading our nation and the world on a Journey to Mars. In October, the agency released a detailed outline of that plan in its report, "NASA's Journey to Mars: Pioneering Next Steps in Space Exploration."

The Journey to Mars crosses three thresholds, each with increasing challenges as humans move farther from Earth. NASA is managing these challenges by developing and demonstrating capabilities in incremental steps:

Earth Reliant exploration is focused on research aboard the International Space Station. From this world-class microgravity laboratory, we are testing technologies and advancing human health and performance research that will enable deep space, long duration missions.

In the **Proving Ground**, NASA will learn to conduct complex operations in a deep space environment that allows crews to return to Earth in a matter of days. Primarily operating in cislunar space — the volume of space around the moon featuring multiple possible stable staging orbits for future deep space missions — NASA will advance and validate capabilities required for humans to live and work at distances much farther away from our home planet, such as at Mars.

Earth Independent activities build on what we learn on the space station and in deep space to enable human missions to the Mars vicinity, possibly to low-Mars orbit or one of the Martian moons, and eventually the Martian surface. Future Mars missions will represent a collaborative effort between NASA and its partners — a global achievement that marks a transition in humanity's expansion as we go to Mars to seek the potential for sustainable life beyond Earth.

The plan can be read online at: http://go.nasa.gov/1VHDXxg

"NASA is closer to sending American astronauts to Mars than at any point in our history."

Charles Bolden
NASA Administrator

Dreamflight NASA Night gives 200 kids vacation to remember

BY AMANDA GRIFFIN

The challenges and obstacles of everyday life took a backseat to fun for nearly 200 children facing an illness or disability. A vacation of a lifetime brought them from the United Kingdom to Orlando, Florida for 10 days of excitement — including an evening of space-themed activities with NASA.

Every year since 1987, UK-based Dreamflight has loaded a chartered 747 jumbo jet with 192 seriously ill or disabled children and their medical caregivers for the mother of all vacations.

"Dreamflight truly is the holiday of a lifetime," said Sally Wrampling, director of Dreamflight. "The children have all been through incredibly difficult times, so we want to make sure they build some great friendships and have lots of fun!"

While in Orlando, the children, ages eight to 14, spend their days at various theme and water parks and they even get to swim with dolphins. For the past four years, NASA has been part of this magical journey for these youngsters with an interactive NASA Night created just for them.

Most kids are exhausted after a day at a water park. But not these kids.

At 7 p.m. on Oct. 22, a few dozen NASA employees from varying fields met the children at their hotel when they returned for dinner. Retired astronaut John Blaha began the evening with thrilling accounts of his days as a space shuttle astronaut. At the end, hands darted in the air with follow-up questions until the rest of the festivities could wait no longer. Activities like how to work in space, riding a hovercraft, taking part in a cool science show and launching stomp rockets with either their hands or their feet — depending on their ability — went on for a few hours until the kids had their fill.

"The team from NASA's Education Projects and Youth Engagement have an amazing ability to deliver educational elements in a fun and interactive way, always ensuring it is tailored to all ages and abilities," said Jason Beamish-Knight, the entertainment team leader for the trip. "And," he added, "the children are never short in expressing their admiration and surprise in meeting a real astronaut."

The charity's goal is to change the kids' young lives. But to the NASA employees who spent only a few hours with these special children, Dreamflight changes the lives of everyone taking part in this amazing endeavor.

"I cannot begin to tell you what a pleasure it was being there last night," recalled Bill Little of KSC's Information and Technology directorate. "Dreamflight NASA Night is by far and away the worthiest outreach effort I've been involved with in all my time with the agency. As fellow volunteer Martha Vreeland and I acknowledged to one another: as long as we are employed at KSC, and as long as Dreamflight keeps coming to Orlando, we'll be there, no questions asked."

"Dreamflight NASA Night is by far and away the worthiest outreach effort I've been involved with in all my time with the agency . . . as long as Dreamflight keeps coming to Orlando, we'll be there, no questions asked."

Bill Little
KSC's Information and Technology directorate

Participants of Dreamflight enjoy the space-themed NASA Night as part of their 10-day stay in Orlando. Photos courtesy of Dreamflight.

To learn more, go to www.dreamflight.org


NBL
CAUTION
NBL
Neutral Buoyancy Laboratory
NASA/JSC
LOCKHEED MARTIN
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Team members from NASA's Orion Program and the Ground Systems Development and Operations Program prepare to practice egress training Oct. 6-8 using a mock-up of the Orion crew module in the 6.2-million-gallon Neutral Buoyancy Laboratory at Johnson Space Center in Houston.

During the three-day testing, personnel simulated approaching the spacecraft floating in the Pacific Ocean and what it would take to assist the crew as they exit. The team evaluated the layout of equipment inside the spacecraft, the gear that will be used during the recovery process and the most efficient way for astronauts to get out of the spacecraft after weeks or months away from Earth.

Orion is the spacecraft that will launch atop NASA's Space Launch System rocket on Exploration Mission-1 in 2018.

Photo credit: NASA/Amber Philman

CLASSROOM Connection

Students explore 'The Martian' with cast, scientist

BY STEVEN SICELOFF

Mars used to look a lot like Earth with two-thirds of the Red Planet's northern hemisphere covered in blue and there is every reason to explore our nearest planetary neighbor in person as students from around the nation were told during a digital learning network event at Kennedy Space Center on Oct. 31 that featured astronauts, scientists and actors from the film "The Martian."

"We in America have the explorer gene," NASA's Jim Green, director of the Planetary Science Division, explained to the students in the room and those participating from classrooms from Texas and Wisconsin to North Carolina, Massachusetts and Pennsylvania. "We want to see what's over the next hill."

Green said the need to find out about Mars and perfect technologies to let humans survive and adapt to the planet are more than scientific curiosity: it's a way to preserve humanity from the periodic disasters on this world such as asteroid impacts.

"Just like you have a backup for your phone and computer, we want a place to back up the human race. The dinosaurs didn't have a space program," he said to laughter and applause.

Two of the actors from the movie, Chiwetel Ejiofor and Mackenzie Davis, said the event gave them a chance to learn about the real work under way to allow human missions to a world 140 million miles away — that's six or seven months in a spaceship and some two years away from Earth round-trip.

"I have no skill set to survive other than relating to other people and emoting," Davis said, "but I did learn a lot about chemistry and math from people who could survive there."

Ejiofor said deep study informed his portrayal of a NASA scientist in the movie.

"I had Wikipedia open all the time, trying to cross-reference everything and learn all I could," Ejiofor said.

As to who would make the real-life trip, former space shuttle commander Bob Cabana, director of Kennedy, advised the students to learn how to adapt quickly and improvise solutions smoothly to problems no one expects. Plus, be ready to pursue goals even in the face of rejection.

"Find your passion," Cabana said. "It takes hard work to become an astronaut and doing what you're passionate about is what's going to make the work fun."

Retired astronaut Nicole Stott suggested those who want to be an astronaut to embrace teamwork quickly since astronauts are implementers of other people's research and projects, not necessarily work that they devised themselves.

A couple of panelists even offered suggestions for where on Mars they would prefer to touch down.

"I actually would go back to the Mars pathfinder landing site," said Dave Lavery, NASA's program executive for Planetary Exploration who was a technical consultant for "The Martian."

"We in America have the explorer gene . . . We want to see what's over the next hill."

Jim Green,
Director of NASA's Planetary Science Division

"I'd like to go back and find out what happened to our rover."

Advances of many sorts will be needed before NASA can undertake its journey to Mars in the 2030s, but some of the devices needed to produce a basic living environment for astronauts are already far along in development.

For example, Anne Meier, a chemical engineer at Kennedy who previously took part in a Mars mission simulation called Hi-SEAS, outlined a system deep into development that pulls oxygen and methane out of Mars' thin atmosphere for use as breathing air and rocket fuel.

Ray Wheeler, a plant physiologist, said the potato crop suggested in the film is a real possibility for future crews to grow on another world for a number of reasons, including the nutrients contained in the crops.

"Until you run out of ketchup," Green added.

Gioia Massa, a researcher whose work on NASA's Veggie experiment has led to the first lettuce grown and consumed in orbit, highlighted the feel of home that plants bring crews during long missions.

"It's something to care for, something to think about and watch grow," Massa said.

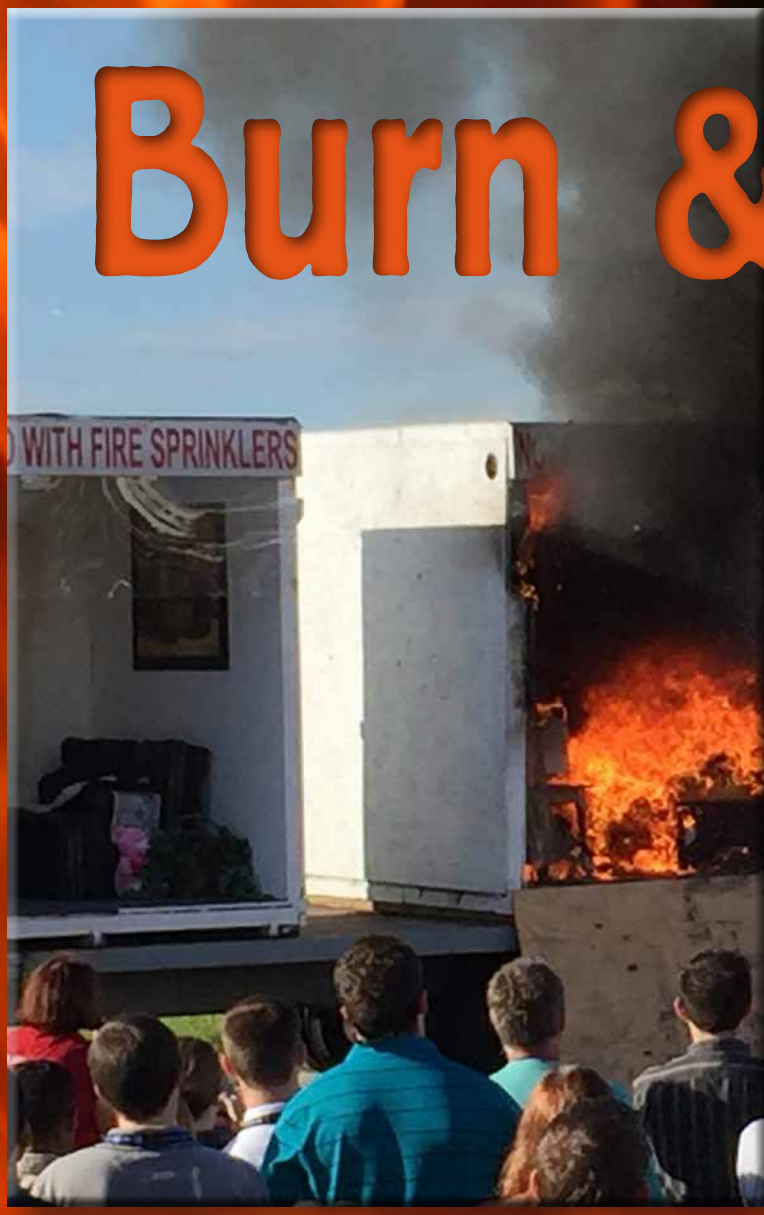
There are plenty of things on Mars for astronauts to worry about, including dust that kicks up quickly in storms and settles on any surface potentially causing a solar array to get covered up and stop producing electricity. The dust also could be brought inside a spacecraft unknowingly on an astronaut's suit. That's why teams of engineers including Michael Johansen are developing devices and techniques that quickly shake or electrically deflect dust away from critical systems.

All the work that goes into making a human journey to Mars is to ultimately gain knowledge about one of the few bodies in the solar system that would be somewhat hospitable to people, Lavery said.

"When we go to Mars, we're going to discover stuff, things that the robotic systems haven't found yet, things that are going to make us sit back and say, 'How did we not see this coming?', but those are the things that I think will be the most valuable and most interesting."

NASA scientists and engineers, along with actors from the 20th Century Fox Entertainment film, "The Martian" participated a series of panel discussions at Kennedy Space Center on Oct. 1. From the left, are Michael Johansen, NASA research engineer; Gioia Massa, NASA project scientist; Nicole Stott, a retired NASA astronaut; Chiwetel Ejiofor, an actor who portrays Vincent Kapoor in the movie; Dave Lavery, NASA program executive for Planetary Exploration and Sarah Ramsey of NASA Communications. Photo credit: NASA/Kim Shiflett

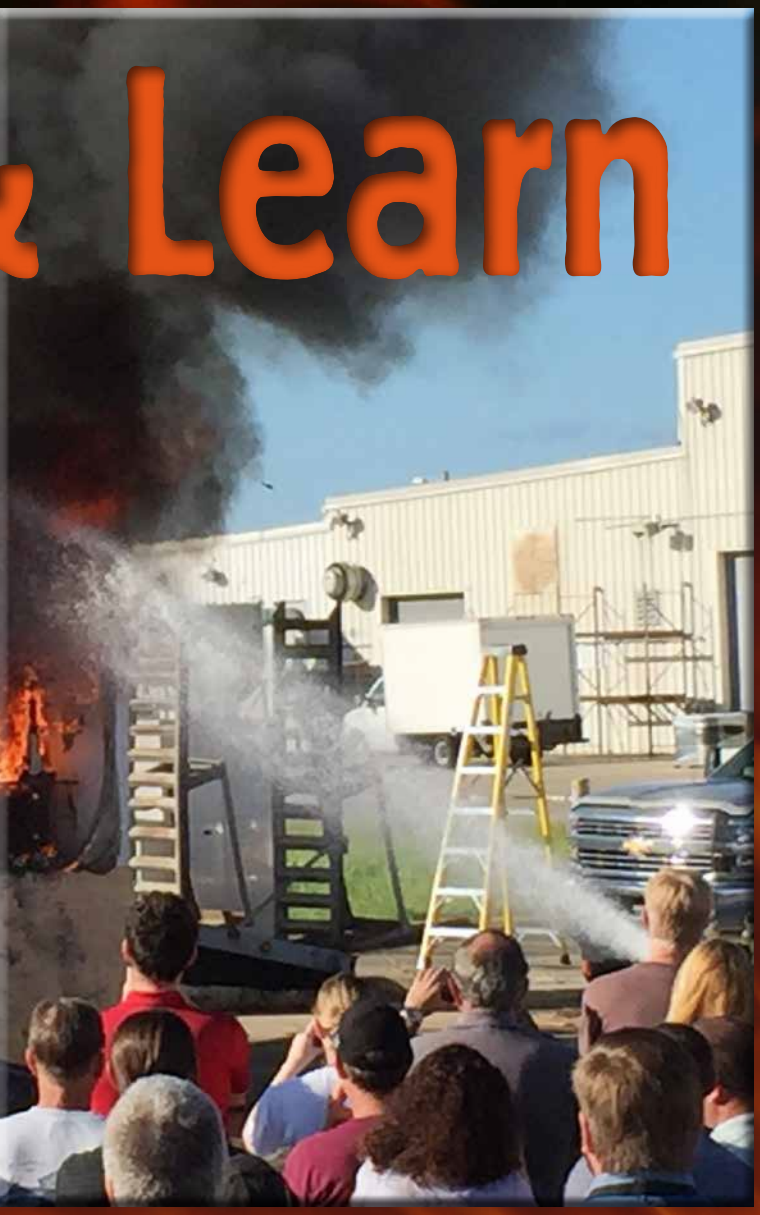
Burn &



Kennedy Space Center employees watch as firefig
demonstration in the Launch Complex 39 area. Th
Fire Protection Association's Fire Prevention Week
a fire can spread in a room without a fire protectio
smoke detectors and fire sprinkler systems in the
Florida Fire Sprinkler Association was on hand to s
Fire Department personnel also were present to p
extinguish the fire.

Photo credit: NASA/Greg Harland

& Learn



ghters extinguish flames during a fire safety
he safety demonstration was part of the National
k, Oct. 4-10. Workers saw firsthand how quickly
on system and the importance of having working
home and office. A representative from the
share statistics and answer questions. Kennedy's
provide support during the demonstration and

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