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National Aeronautics and
Space Administration

KENNEDY SPACE CENTER'S

SPACEPORT magazine

SPACEPORT TRANSFORMATION REVOLUTIONIZES COMMERCIAL SPACE

KENNEDY SPACE CENTER'S

SPACEPORT MAGAZINE

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COVER: The iconic Vehicle Assembly Building and several processing and support facilities are shown in this aerial view of NASA's Kennedy Space Center. Photo credit: NASA/Kim Shiflett

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NASA'S LAUNCH SCHEDULE

Date: July
Mission: Expedition 52 Launch
Description: Expedition 52/53 crew members Randy Bresnik of NASA, Paolo Nespoli of ESA (European Space Agency) and Sergey Ryazanskiy of the Russian space agency Roscosmos launch to the International Space Station aboard the Soyuz MS-06 spacecraft from the Baikonur Cosmodrome in Kazakhstan.
https://go.nasa.gov/2oJzivW

Date: Aug. 3
Mission: Tracking and Data Relay Satellite-M (TDRS-M)
Description: Orbiting 22,300 miles above Earth, the TDRS spacecraft provide near-constant communication links between the ground and orbiting satellites, such as Hubble and the International Space Station. TDRS-M will launch from NASA's Kennedy Space Center in Cape Canaveral, Florida, on a United Launch Alliance Atlas V rocket.
http://go.nasa.gov/2l8Hysg

Date: September
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: September
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 space station aboard the Soyuz MS-06 spacecraft from the Baikonur Cosmodrome in Kazakhstan.
https://go.nasa.gov/2rkRChR

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?
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 the KSC Visitor Complex at **321-449-4444** for information on purchasing tickets.

I am KENNEDY
SPACE CENTER

ANNA VASTOLA

I am a senior vehicle system engineer for NASA's Launch Services Program, or LSP.

I was born and raised in San Valentino Torio, a small town in southern Italy. It wasn't until my last year of high school that a course in astronomical geography sparked my love for space exploration. I felt then that I was going to somehow one day contribute to writing books on the subject.

I moved to the United States when I was 19 and learned English. Four years later, I graduated from the University of Florida with a bachelor's in material science and engineering, co-owned three businesses, and was mother of a beautiful baby — Alessandro. After graduating, I went back to school to earn a doctorate degree, but shortly after, I interviewed with NASA at a career fair, and eight months later I was working for LSP!

At LSP, I'm part of a knowledgeable and experienced team of engineers that oversee launch vehicle, launch operations, and countdown management of NASA missions aboard expendable launch vehicles. I've supported several notable missions, including Kepler, SDO, MMS, MAVEN and OSIRIS-REx.

NASA also has supported my continued education and helped me earn a master's degree in program management at the University of Central Florida — a step in the direction of my childhood, ambitious dream of becoming a CEO.

Being apart from my family in Italy is difficult for me as they are the force behind all my strengths and accomplishments. However, I feel truly blessed to be part of NASA!

SPACEPORT TRANSFORMATION

NASA vision sparked commercial space revolution on Space Coast

BY BOB GRANATH

"We knew we had to find a way to eliminate 'red tape' and unnecessary regulations and bureaucracy. This was the game changer."

– Janet Petro, Deputy Director Kennedy Space Center

The Vehicle Assembly Building, Launch Control Center and mobile launcher tower cast a reflection in the water at NASA's Kennedy Space Center in Florida. Photo credit: NASA

Well before the final space shuttle touched down in 2011, the burgeoning commercial space industry was expressing interest in expanding business pursuits in space. At the same time, NASA's Kennedy Space Center in Florida found itself in a unique position. For over 30 years, most of the center's resources were dedicated to the express purpose of supporting the Space Shuttle Program. Now, Kennedy was left with excess facilities and capacity with no program requirements or funding.

How would the center and its workforce respond with this change in role?

A more comprehensive vision was required to meet the emerging needs of both the civil and commercial space industries as the Space Shuttle Program was officially slated to end. Center leadership began looking to the future by developing an innovative concept for the historic Florida launch site: a new multi-user spaceport.

Deputy Center Director Janet Petro was tasked with chairing the Master Plan Steering Group, a team composed of agency and center experts committed to maximizing Kennedy's competitive position, namely its experience, location and infrastructure, to meet the nation's forthcoming spacefaring needs. This "Future Development Concept," developed in 2012, called for NASA to extensively partner with industry, remove unnecessary government oversight and allow commercial ventures to conduct operations using agency facilities and launch pads. Additionally, plans called for aerospace companies to fly astronauts from a multi-user spaceport.

A SpaceX Falcon 9 rocket lifts off from Launch Complex 39A at NASA's Kennedy Space Center on June 3, 2017. This is the company's 11th commercial resupply services mission to the International Space Station. In the future, the Falcon 9 Heavy will lift off the former Apollo and shuttle launch pad with the SpaceX Crew Dragon spacecraft. Photo credit: NASA/Tony Gray

"We looked at the landscape searching for the best way to use the available assets," Petro said. "We realized we needed to change our focus from a big government, NASA-only space center to the agency partnering with others."

This operational model change was unprecedented. Some questioned whether it should be done. Even if this transformation

The upper and lower dome sections of a CST-100 Starliner are mated to complete the first hull of the Starliner's structural test article May 2, 2016, in the Commercial Crew and Cargo Processing Facility (C3PF) at NASA's Kennedy Space Center in Florida. The C3PF was Bay 3 of the Orbiter Processing Facility during the space shuttle era. Photo credit: Boeing

could be accomplished, many believed it would take many years for these changes to become a reality.

But this new vision sparked a commercial space revolution at the center.

At a Kennedy Partnership Landscape Forum, Center Director Bob Cabana explained the center's new approach.

"Now we've got multiple commercial customers and we're utilizing center assets to become a spaceport with government and commercial operations," he said. "If you look at what we're putting in place here at Kennedy, it's pretty amazing."

In 2015, well ahead of expectations, Kennedy met the objective of becoming a premier, multi-user spaceport, as laid out in its Master Plan.

Partners from government, industry and academia are finding new uses for Kennedy's unique assets as the agency turns over no longer needed facilities. Whether it's Blue Origin, planning to build rockets on Kennedy property at Exploration Park; Boeing, modernizing the shuttle's Orbiter Processing Facility to develop their Starliner spacecraft to ferry astronauts to the space station; or SpaceX, launching rockets with cargo -- and soon crews -- to the

A United Launch Alliance Atlas V rocket arrives at Space Launch Complex 41 at Cape Canaveral Air Force Station on March 21, 2016. The Cygnus spacecraft aboard is scheduled to deliver supplies on the Orbital ATK CRS-6 mission to the International Space Station. Photo credit: NASA/Ben Smegelsky

station, the Florida spaceport now is the cornerstone of spaceflight.

The goal was fulfilled by successfully attracting commercial partners, but in doing so, NASA had to change the way it does business.

"We knew we had to find a way to eliminate 'red tape' and unnecessary regulations and bureaucracy," Petro said. "This was the game changer. Removal of unwarranted government oversight has led to innovation and efficiency."

Click here for the full story on how Kennedy became a premier, multi-user spaceport.

SPACEPORT UPDATE

Bob Cabana, director of NASA's Kennedy Space Center in Florida, speaks with community leaders about changes and progress underway at the Florida spaceport. Photo credit: NASA/Bill White

Kennedy's transformation paying off in new opportunities

BY STEVEN SICELOFF

A transformation begun before the space shuttles retired six years ago set the stage at NASA's Kennedy Space Center in Florida for the current development underway among commercial space companies and for the infrastructure needed to support deep space exploration, Bob Cabana, Kennedy's director, told community leaders June 13.

"When you look back in all of human history, only three nations have sent humans into orbits: the United States, Russia and China," Cabana said. "Now, across Kennedy Space Center, there are four United States companies building hardware and infrastructure to send humans into orbit: Lockheed Martin, SpaceX, Boeing and Blue Origin. That's pretty amazing. When we look at the transition, we have an outstanding future and we have a great plan put into place."

Speaking to an audience of about 200 officials and business leaders from the communities around the Florida spaceport, Cabana said the launch facility has diversified in robust ways, ranging from retooling existing structures for new programs to building new facilities, such as the rocket factory Blue Origin and OneWeb's satellite manufacturing center in Exploration Park.

Kennedy's space business portfolio expanded from shuttles and uncrewed rockets lifting probes into space to include a host of companies building new classes of launchers, processing hangars for rockets and assembly halls for satellites. A partnership with the Air Force is in place, too, for the processing of its spacecraft.

To that can be added the assembly and processing facilities for NASA's Orion spacecraft and Space Launch System rocket,

A presenter details the overall plans for NASA's Kennedy Space Center for local community and industry leaders. Photo credit: NASA/Bill White

the combination envisioned to launch astronauts to destinations in deep space in 2019.

"We've got everything we need to do what we said we're going to do," Cabana told the audience. "We're going to continue to execute the plan we have to enable our operations, as well as to keep Space Launch System and Orion going."

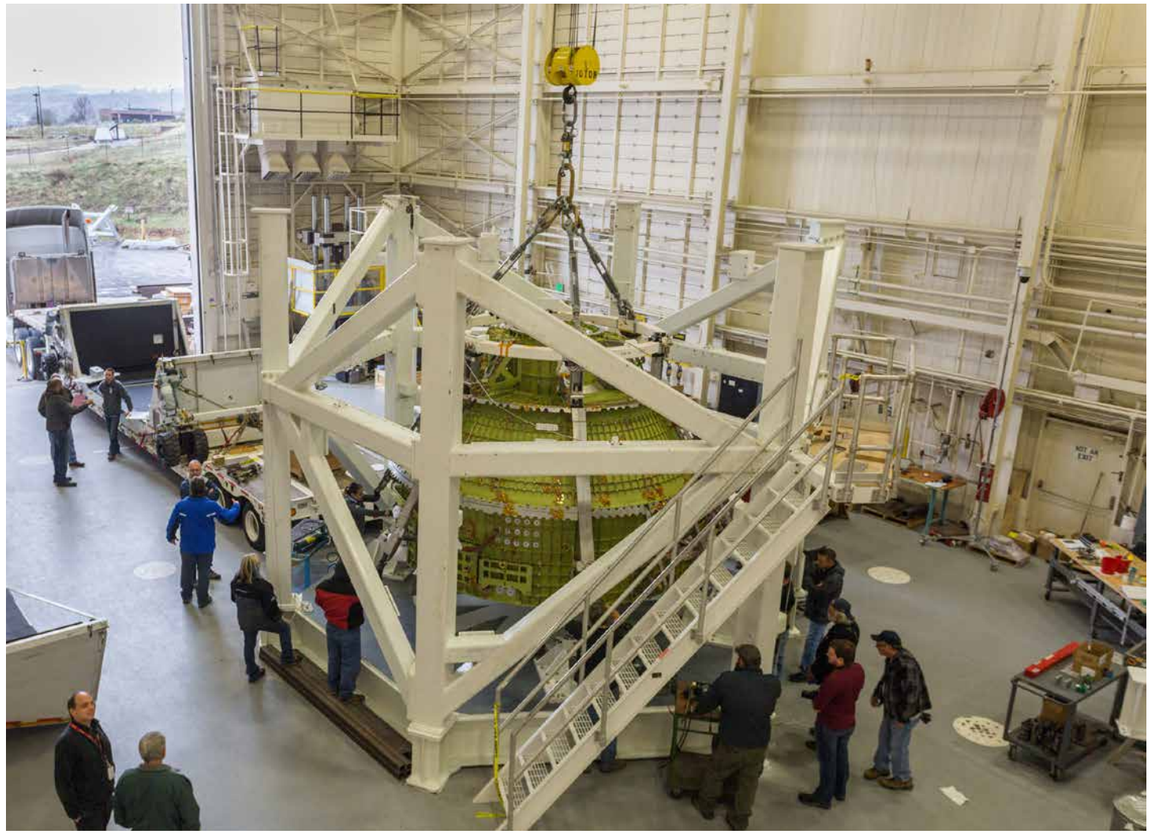
Charlie Blackwell-Thompson, launch director for NASA's Ground Systems Development and Operations Program at Kennedy, said the center's change showed a lot of people what was possible for the next generation of the storied launch center.

"Some people thought our work was done when the shuttles retired, but people are realizing now our work has changed but it's just as exciting," Blackwell-Thompson said. "It's diverse, it's different from what it was back in shuttle, but it's pretty amazing."

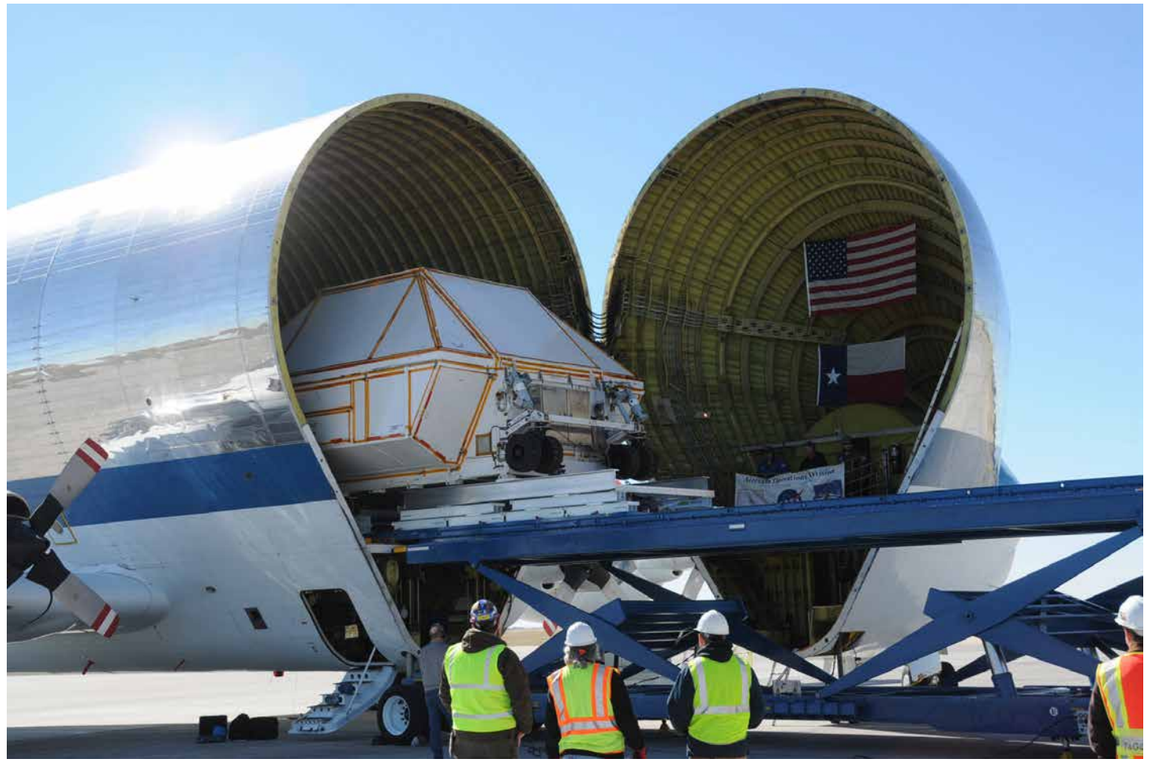
Bob Sieck, a retired space shuttle launch director who has served on NASA advisory panels, said the task of turning the center's focus around and being rewarded relatively quickly with companies eager to operate existing facilities and build new ones proves the plan was solid from the start.

"When you consider where we were six years ago and where we are today, I'd say it looks really good," Sieck said. "The changes are adapting to what society now wants: a modernized facility and a robust program to apply all this talent to. They said this is not the end of Kennedy, just watch us. We're going to make it so companies want to come here to launch and manufacture. It's starting to look like what it did when we went to the moon."

PREPPING FOR EM-1



The Orion Exploration Mission-1 crew module structural test article was delivered to Lockheed Martin Space Systems' Waterton facility near Denver on April 27, 2017. The module was placed in a large ridge test fixture to prepare for loads testing. Photo credit: Lockheed Martin



NASA's Super Guppy aircraft arrived at Buckley Air Force Base near Denver on April 26, 2017. The Orion Exploration Mission-1 crew module structural test article, enclosed in its shipping container, was offloaded for transfer to Lockheed Martin Space Systems' Waterton facility near Denver. Photo credit: Lockheed Martin

Test version of Orion crew module to validate spacecraft design

BY LINDA HERRIDGE

While flight hardware for NASA's Orion crew module is undergoing work in Florida, near-identical structural test articles for the spacecraft are coming together in a test facility across the country in Colorado. Engineers at Lockheed Martin's Waterton facility in Denver will conduct a series of tests to confirm Orion's design is structurally sound and ensure the spacecraft is ready for deep-space missions.

"Testing is integral to demonstrating events and collecting data used to validate the spacecraft design for Orion's next flight," said Dan Qvale, the Orion mechanical test engineering manager with Lockheed Martin.

Orion's structural test article is comprised of three main elements: a crew module, service module and the launch abort system. Unlike the flight hardware, Orion's structural test articles lack electronics or propulsion systems, except the electronics needed to support testing. During the next few months, the test articles will undergo load, acoustic, vibration, shock and lightning tests. Some tests are done on individual parts, and other parts are tested together to expose the system to stresses expected in flight.

"The load tests, for example, will create the forces on Orion that the spacecraft needs to withstand during launch and landing events," Qvale said.

Acoustic testing will simulate the sound the rocket produces and will be used to measure the vibration from the sound to test how it affects Orion. A series of shock tests will ensure shock levels don't exceed what the components have been designed to survive. Simulated lightning tests will monitor how Orion reacts to close or nearby lightning strikes.

"All of these tests, except the lightning test, will help engineers validate the vibration and shock levels that Orion has been designed to withstand throughout the mission," Qvale said.

NASA is testing Orion to ensure it is ready for its first integrated mission with the agency's new Space Launch System rocket in 2019. During that uncrewed flight test, known as Exploration Mission-1, Orion will travel tens of thousands of miles beyond the moon and return home with a splashdown in the Pacific Ocean.

Three teams each earned a $20,000 prize check and a slot to launch their CubeSat on Exploration Mission-1, the first integrated flight of NASA's Space Launch System. From left are NASA Associate Administrator of the Space Technology Mission Directorate Steve Jurczyk, Benjamin Fried of team CU-E3, Kyle Doyle of team Cislunar Explorers, Wesley Faler of Team Miles, and NASA Ames Research Center Director Eugene Tu. Credits: NASA/Dominic Hart

Three DIY CubeSats score rides on NASA's first flight of Orion, Space Launch System

NASA's Space Technology Mission Directorate (STMD) has awarded rides for three small spacecraft on the agency's newest rocket, and $20,000 each in prize money, to the winning teams of citizen solvers competing in the semifinal round of the agency's Cube Quest Challenge.

The three winning teams secured space to launch their CubeSats on Exploration Mission-1, the first integrated flight of NASA's Space Launch System (SLS) and Orion spacecraft. Once deployed, the CubeSats will vie for a share of a $5 million prize in the first-ever competition in deep space. The three teams are Cislunar Explorers, Cornell University, Ithaca, New York; CU-E3, University of Colorado Boulder; and Team Miles, Fluid & Reason LLC, Tampa, Florida.

"We are delighted in the profound achievements of these teams," said Steve Jurczyk, STMD associate administrator. "Each team has pushed the boundaries of technology and innovation. Now, it's time to take this competition into space – and may the best CubeSat win."

To read the complete story, visit **https://go.nasa.gov/2rUJ0yO.**

The United Launch Alliance Delta II rocket stands on Space Launch Complex 2 at Vandenberg Air Force Base in California on April 11, 2017. It is scheduled to launch the Joint Polar Satellite System-1 (JPSS-1) later this year. JPSS, a next-generation environmental satellite system, is a collaborative program between the National Oceanic and Atmospheric Administration (NOAA) and NASA. Photo credit: NASA/Randy Beaudoin

Crew Dragon trainer takes shape at Kennedy Space Center

BY STEVEN SICELOFF

NASA and SpaceX engineers are working together at NASA's Kennedy Space Center in Florida to build a full-scale Crew Dragon model, or Recovery Trainer, that will be used by the U.S. Air Force to perform flight-like rescue and recovery training exercises in the open ocean later this year.

The model, shown above with astronauts Dan Burbank and Victor Glover inside, is built to mimic the Crew Dragon spacecraft that SpaceX is developing with NASA's Commercial Crew Program to fly astronauts to and from the International Space Station. In certain unusual recovery situations, SpaceX may need to work with the U.S. Air Force to send parajumpers to recover astronauts from the capsule. The Recovery Trainer will be used by the Air Force to prepare procedures and train for this contingency scenario. The trainer also has two working hatches and other simulated components similar to the ones astronauts and support teams will encounter in real missions.

Scott Colloredo, deputy director of Kennedy's Engineering Directorate, said the engineers adapted SpaceX designs of internal elements to be compatible with the trainer and worked with Kennedy's Prototype Development Lab to produce the parts quickly and install them inside the trainer. The Prototype Development Lab designs, fabricates and tests prototypes, test articles and test support equipment. The lab has a long history of providing fast solutions to complex operations problems. The lab's teams of engineers use specialized equipment to produce exacting, one-of-a-kind items made from a range of materials depending on the design.

"We perform things that complement what the partners and programs provide," Colloredo said. "The team delivered right to the minute."

SpaceX is now finalizing modifications to the trainer to ensure it floats in water in the same way as the Crew Dragon spacecraft. Following those modifications, the trainer will enter service as the primary training vehicle for Crew Dragon astronaut recovery operations.

NASA astronauts Dan Burbank, left, and Victor Glover, sit inside the Recovery Trainer, a full-scale model of the SpaceX Crew Dragon. Photo credit: SpaceX

NEWEST EXPLORERS

NASA announces astronaut candidates for 2017

Vice President Mike Pence joined Acting NASA Administrator Robert Lightfoot at the agency's Johnson Space Center in Houston on June 7 to welcome America's newest astronaut candidates. The twelve candidates were selected from more than 18,300 applicants to carry the torch for future human exploration.

NASA announced its 2017 Astronaut Candidate Class on June 7, 2017. The 12 candidates, pictured here at NASA's Ellington Field in Houston, from left are Zena Cardman, U.S. Marine Corps Maj. Jasmin Moghbeli, U.S. Navy Lt. Jonny Kim, U.S. Army Maj. Francisco "Frank" Rubio, U.S. Navy Lt. Cmdr. Matthew Dominick, Warren "Woody" Hoburg, Robb Kulin, U.S. Navy Lt. Kayla Barron, Bob Hines, U.S. Air Force Lt. Col. Raja Chari, Loral O'Hara and Jessica Watkins. Photo credit: NASA/Robert Markowit.

MEET THE ASTRONAUT CANDIDATES

Kayla Barron

The Washington native graduated from the U.S. Naval Academy with a bachelor's degree in systems engineering. A Gates Cambridge Scholar, Barron earned a master's degree in nuclear engineering from the University of Cambridge.

Warren Hoburg

The Pennsylvania native earned a bachelor's degree in aeronautics and astronautics from the Massachusetts Institute of Technology and a doctorate in electrical engineering and computer science from the University of California, Berkeley.

Matthew Dominick

The Colorado native earned a Bachelor of Science in electrical engineering from the University of San Diego and a Master of Science in systems engineering from the Naval Postgraduate School. He graduated from the U.S. Naval Test Pilot School.

Zena Cardman

The Virginia native completed a Bachelor of Science in marine sciences at the University of North Carolina, Chapel Hill. Her research focused on microorganisms in subsurface environments, ranging from caves to deep-sea sediments.

Bob Hines

The Pennsylvania native earned a bachelor's degree in aerospace engineering from Boston University. He is a graduate of the U.S. Air Force Test Pilot School, where he earned a master's degree in flight test engineering. He continued on to earn a master's degree in aerospace engineering from the University of Alabama.

Raja Chari

The Iowa native graduated from the U.S. Air Force Academy in 1999 with bachelor's degrees in astronautical engineering and engineering science. He continued on to earn a master's degree in aeronautics and astronautics from the Massachusetts Institute of Technology and graduated from the U.S. Naval Test Pilot School.

Loral O'Hara

The Texas native earned a Bachelor of Science in aerospace engineering at the University of Kansas and a Master of Science in aeronautics and astronautics from Purdue University.

Frank Rubio

The Florida native graduated from the U.S. Military Academy and earned a Doctorate of Medicine from the Uniformed Services University of the Health Sciences.

Jessica Watkins

The Colorado native earned a bachelor's degree in geological and environmental sciences at Stanford University, and a doctorate in geology from the University of California, Los Angeles.

Jonny Kim

The California native trained and operated as a Navy SEAL, completing more than 100 combat operations and earning a Silver Star and Bronze Star with Combat "V." Afterward, he went on to complete a degree in mathematics at the University of San Diego and a Doctorate of Medicine at Harvard Medical School.

Robb Kulin

The Alaska native earned a bachelor's degree in mechanical engineering from the University of Denver, before going on to complete a master's degree in materials science and a doctorate in engineering at the University of California, San Diego.

Jasmin Moghbeli

The New York native earned a bachelor's degree in aerospace engineering with information technology at the Massachusetts Institute of Technology, followed by a master's degree in aerospace engineering from the Naval Postgraduate School.

Go to https://www.nasa.gov/2017astronauts for more information on the candidates and astronaut selection.

National Aeronautics and Space Administration

KENNEDY SPACE CENTER
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GROUND SYSTEMS DEVELOPMENT & OPERATIONS

Vicki Cox
Senior Management and Program Analyst
Ground Systems Development & Operations Program

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SP-2017-06-681-KSC

Vicki Cox

Senior Management and Program Analyst

My name is Vicki Cox. I am a senior management and program analyst. I work in the Program Planning and Control Division of the Ground Systems Development and Operations Program (GSDO) at NASA's Kennedy Space Center in Florida.

I support GSDO by ensuring the Kennedy LX Support Services contract requirements support the GSDO mission goals and include ground systems development and operational planning for launch vehicles, spacecraft and payloads. My role directly strengthens the GSDO Program community through enhancing capabilities for workforce, processes and tools.

I absolutely love that I interface directly with all levels of GSDO management and have direct influence on the way mission requirements are met by our support contractors. I am incredibly excited and extremely privileged to actually be a part of this amazing team that is making history with the upcoming Exploration Mission-1 and subsequent launches that will prepare us for deep space exploration.

I came to Kennedy in 2000 as a graduate co-op student and worked in the Staff Office of the Joint Program Management Office on Cape Canaveral Air Force Station. I then worked on the Institutional Support Contract Source Evaluation Board and in multiple positions in the Center Operations Directorate. I served as the lead in the newly established Contract Management Branch and oversaw all contract activities on six institutional contracts. I moved to lead the Center Operations Directorate Logistics and Services Branch before transitioning to GSDO in 2015.

I was truly honored to receive Employee of the Month after only working in the GSDO Program for seven months. Earlier this year, I received a Certificate of Appreciation for my contributions to GSDO. My most recent achievement was being asked to serve as a voting member on the Kennedy LX Support Contract-III (KLXS-III) Source Evaluation Board.

I've always loved looking up at the night sky and being intrigued by the wonder of God's beautiful creation. I was curious about the universe and life on other planets. I wondered what it would be like to visit those planets and see if they were similar to Earth. I never imagined that working for NASA was even a possibility for me because I thought everyone who worked for NASA was an astronaut, astronomer, scientist or engineer. Did I mention that calculus was very challenging for me?

I grew up in Alexandria, Louisiana, and consider it to be my hometown. I moved to Brevard County, Florida, in 1998, after visiting my best friend who was stationed at nearby Patrick Air Force Base. While on vacation, I was able to witness my very first shuttle launch. I believe it was STS-91. That was my first true taste of the Space Coast and NASA, and I immediately fell in love with all of it. I was so moved and inspired by the astonishing launch that I decided I wanted to be part of the amazing team that was sending astronauts to space.

During the remainder of my vacation, I went out and found a job and rented a home. I was serious about moving here. When I returned home, I turned in my two-week resignation, packed up my belongings and dog, and moved to the Space Coast to follow my dream.

I earned a Bachelor of Science in psychology from Louisiana State University in 1994 (Geaux Tigers!), and a Master of Arts in management and leadership from Webster University in 2001.

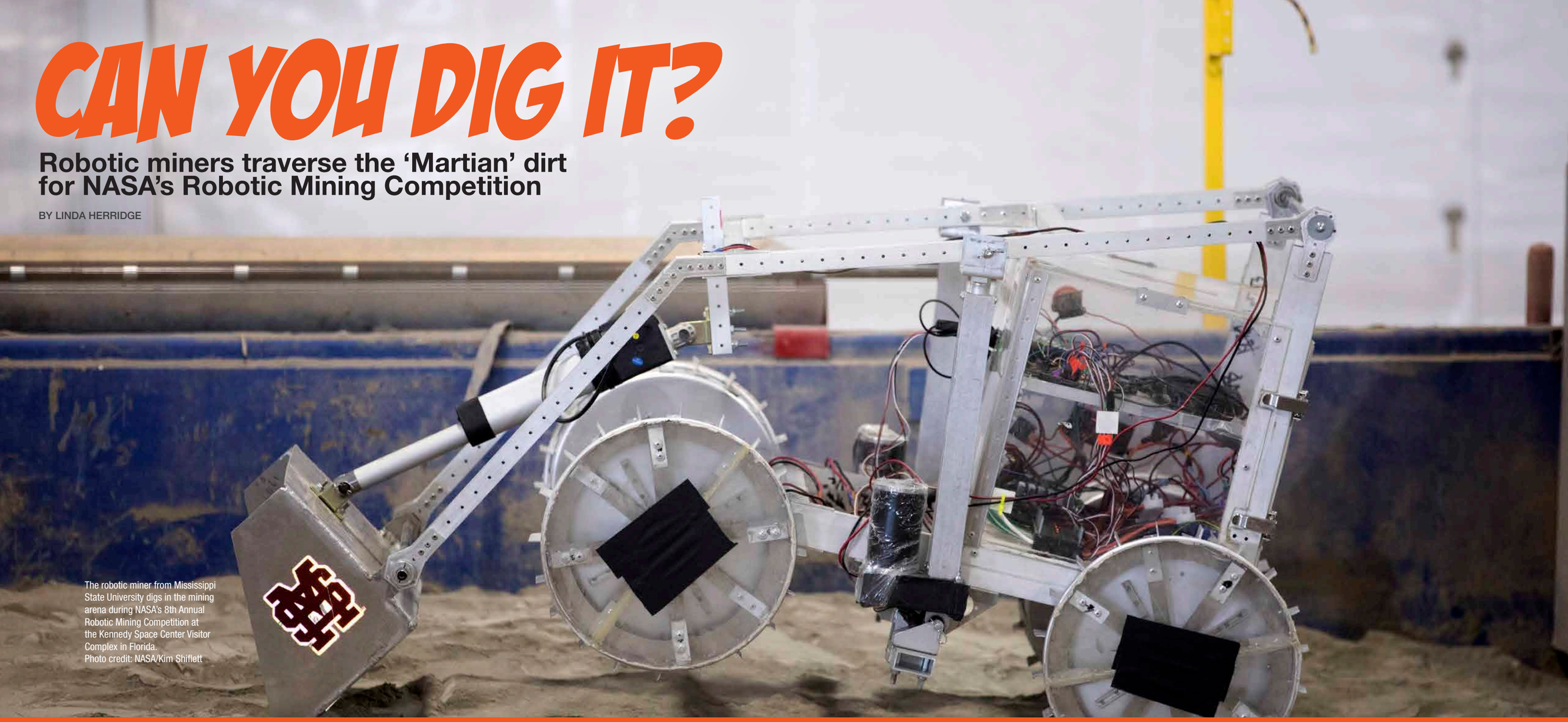
The advice I would give students interested in a career similar to mine is that there are more than scientific and engineering professions at NASA. NASA needs all kinds of people to fill all kinds of positions. Spend time researching what requirements are necessary to obtain an internship with NASA and start working on your "to-do list." You can do anything you want if you commit to it by setting goals, working hard, taking risks and never giving up.

NASA's TDRS-M satellite arrived inside its shipping container at Space Coast Regional Airport in Titusville, Florida, aboard a U.S. Air Force transport aircraft June 23, 2017. The spacecraft was transported to the nearby Astrotech facility, also in Titusville, for preflight processing. The TDRS-M is the latest spacecraft destined for the agency's constellation of communications satellites that allows nearly continuous contact with orbiting spacecraft, ranging from the International Space Station and Hubble Space Telescope to an array of scientific observatories. Liftoff atop a United Launch Alliance Atlas V rocket is scheduled to take place from Space Launch Complex 41 at Cape Canaveral Air Force Station at 9:02 a.m. EDT Aug. 3, 2017.
Photo credit: NASA/Kim Shiflett

CAN YOU DIG IT?

Robotic miners traverse the 'Martian' dirt for NASA's Robotic Mining Competition

BY LINDA HERRIDGE



The robotic miner from Mississippi State University digs in the mining arena during NASA's 8th Annual Robotic Mining Competition at the Kennedy Space Center Visitor Complex in Florida.
Photo credit: NASA/Kim Shiflett

Team Astrobotics from the University of Alabama received the top award, the Joe Kosmo Award for Excellence, at NASA's Eighth Annual Robotic Mining Competition (RMC) awards ceremony May 26. The mining competition was held May 22-26 at the Kennedy Space Center Visitor Complex.

The RMC is a NASA Human Exploration and Operations Mission Directorate project designed to encourage students in science, technology, engineering and math, known as STEM fields. The project provides a competitive environment to foster innovative ideas and solutions that could be used on NASA's Journey to Mars.

Joe Kosmo, for whom the top award is named, is a retired NASA engineer with a keen interest and background in robot mining. He served several years as an advisor and judge during the competition.

"It's been a wonderful experience. It's humbling," said Joseph Kabalin, graduating senior and Team Astrobotics lead. "We know how hard it is to get here for the competition. Our hats are off to all of the other teams."

Team Astrobotics took first place in the Robotic On-Site Mining category, collecting a total of 336 kilograms of regolith during two mining runs. Their robot accomplished all of the mining autonomously, without communication from the team or use of a remote-controlled device in the control room.

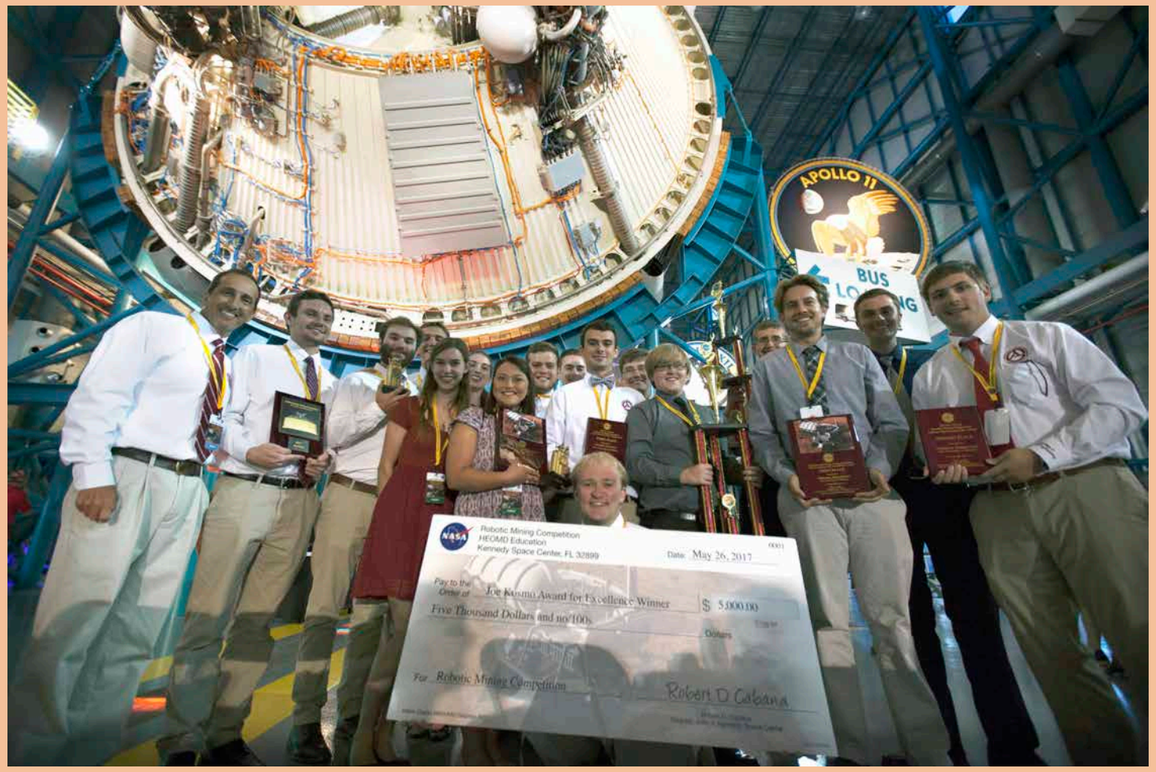
"Before we go to Mars, we need to learn about it. We need to pre-stage supplies and equipment," said Kennedy Center Director Bob Cabana. "There's a lot we can accomplish using robots."

The weeklong competition featured teams of undergraduate and graduate students from 45 colleges and universities across the United States. They traveled with their robot miners to Kennedy from schools in Alaska, Hawaii, Utah, New Hampshire, the Commonwealth of Puerto Rico, and the Florida cities of Gainesville, Melbourne and Orlando.

Before traveling to the space coast, each team spent up to a year planning, designing, building and testing robots that can traverse in a mining arena filled with simulated Martian terrain or regolith, called BP-1, excavate the regolith and deposit it into a collector bin within 10 minutes.

Each team's robot had two opportunities to traverse and excavate simulated Martian dirt, seeking to move and collect the most regolith within a specified amount of time. Teams had to mine a combined total of at least 10 kilograms to qualify for the mining portion of the competition.

From control rooms near the mining area, teams monitored their autonomous robots or commanded their robots to perform the intricate movements required to collect the regolith and maneuver



Team Astrobotics from The University of Alabama won the top award, the Joe Kosmo Award for Excellence, and several other awards, during NASA's 8th Annual Robotic Competition award ceremony May 26, inside the Apollo-Saturn V Center at Kennedy Space Center in Florida. More than 40 student teams from colleges and universities around the U.S. used their uniquely designed mining robots to dig in a supersized sandbox filled with BP-1, or simulated Martian soil, and participated in other competition requirements May 22-26 at the Kennedy Space Center Visitor Complex. Photo credit: NASA/Leif Heimbold

through the rocky terrain to the collector bin and complete the task. Hidden below the surface of the regolith was a layer of small rocks, representing ice water below the simulated regolith surface. This change brought the competition more in line with the requirements of future off-world mining missions.

Other RMC competition categories included submission of a systems engineering paper, and a slide presentation and robot demonstration. Also factored in was how well each team reached out to its community through social media and engagement with area schools and the general public.

Rob Mueller, lead judge for the mining competition, is a NASA senior technologist for Advanced Projects Development in the Exploration Research and Technology Directorate at Kennedy.

"Once again, the university teams showed a remarkable variety of designs for Mars mining robot prototypes," Mueller said. "This year, many machines showed increasing sophistication of robotic perception sensors and autonomy software, reflecting the general advancement of available technologies with reduced costs."

Several teams tried out new innovations this year, ranging from 3-D printed parts and twin robotic miners, to making adjustments or adding parts in real time to solve problems.

First-time participant was the Scarlet Space Hawks team from the Illinois Institute of Technology, Armour College of Engineering. They designed and built their robot, named "Lofty," in just three months. Their efforts paid off with 72 kilograms of mined regolith and a third-place award in the Robotic On-Site Mining category.

"It is mind-blowing, seeing all of the cool robots here," said Shawn Zachariah, a junior studying electrical engineering. "We wanted to go with a simple design. We plan to return for the 2018 competition."

Also a first-timer was Trickfire Robotics, from the University of Washington-Bothell. They had some issues with their robot "Daybreak" tipping in the mining arena during practice runs.

"We added a third wheel in between the front and back wheels on both sides of our robot to help with stability, and it worked," said team member Brian Gonzalez-Montoya.

In their eighth year of competition, the team from University of Nebraska-Lincoln improved on previous designs and used 3-D printed wheels, eight inches in diameter and five inches thick. The auger, or digger, also printed from composite material, was used to mine deep below the surface and bring a section of the regolith to the surface to scoop it up. Making more parts from 3-D printed

NASA's 8th Annual Robotic Mining Competition Teams 2017

- Auburn University
- Case Western Reserve University
- Colorado School of Mines
- Embry-Riddle Aeronautical University
- Florida Institute of Technology
- Illinois Institute of Technology
- Iowa State University
- John Brown University
- Kent State University
- Mississippi State University
- Montana State University
- Montana Tech
- New York University Tandon School of Engineering
- North Dakota State University
- Oakton Community College
- Polytechnic University of Puerto Rico
- Purdue University
- South Dakota School of Mines & Technology
- Temple University
- Texas A&M International University
- The University of Akron
- The University of Alabama
- The University of North Carolina at Charlotte
- The University of Utah
- University of Alaska Fairbanks
- University of Arkansas
- University of Central Florida
- University of Colorado Boulder
- University of Florida
- University of Hawaii-Hilo
- University of Illinois at Chicago
- University of Illinois at Urbana-Champaign
- University of Michigan
- University of Nebraska-Lincoln
- University of New Hampshire
- University of North Dakota
- University of North Florida
- University of Virginia
- University of Washington Bothell
- University of Wisconsin - Madison
- Virginia State University
- Virginia Tech
- West Virginia University
- Worcester Polytechnic Institute
- York College

Twin mining robots from the University of Iowa dig in a supersized sandbox filled with BP-1, or simulated Martian soil, during NASA's 8th Annual Robotic Mining Competition at the Kennedy Space Center Visitor Complex in Florida. Photo credit: NASA/Kim Shiflett

Team members from the New York University Tandon School of Engineering transport their robot to the mining arena during NASA's 8th Annual Robotic Mining Competition at the Kennedy Space Center Visitor Complex in Florida. Photo credit: NASA/Kim Shiflett

composites helped reduce the robot's weight.

Also in its eighth year at RMC, the Cyclone Space Mining Club from Iowa State University spent a full year building two robots, "Space Ketchup" and "Space Mustard." According to Jakob Hartl, a graduating senior in aerospace engineering, the team focused on high efficiency and doubling the production capability of previous years. In the mining arena, one robot failed, but the second one continued to mine the regolith and deposit it in the collection bin.

Montana State University's team took their design in a new direction. Their SCARAB robot's tracks were designed to dig, much like an animal digs with its front paws, and send the regolith behind to its collector bin.

Mueller said the Robotic Mining Competition is important to NASA. Most of the resources available in space are contained in the regolith. In order to take advantage of these resources for in-situ resource utilization -- living off the land -- the regolith must first be excavated and then delivered to a processing plant to extract water, silicates and minerals.

"We are looking for ideas. We need small robots that can do big things," said Pat Simpkins, director of Kennedy's Engineering Directorate. "Robotics is hard, but robotics in space is doubly hard, whether it's on the moon, Mars or another destination in space."

For more information on the RMC, associated activities and social media, visit **http://www.nasa.gov/nasarmc.**

WINNERS LIST

Grand Prize: The Joe Kosmo Award for Excellence

Awarded to the team that scores the most points in all competition events.

Winner: The University of Alabama

On-Site Mining Award

Awarded to the team that passes robot and communication inspections, mines more than 10 kilograms of regolith, has most efficient use in bandwidth, minimizes robot mass, reports energy consumed, has a dust-tolerant design and performs dust-free operations, performs telerobotic and/or autonomously, and mines the most resources.

First Place: The University of Alabama
Second Place: University of Colorado at Boulder
Third Place: Illinois Institute of Technology

Systems Engineering Paper

Awarded to the teams that best discuss the systems engineering methods used to design and build their mining robot. The paper is peer reviewed by support and operations personnel from across NASA.

First Place: Case Western Reserve University
Second Place: The University of Alabama
Third Place: The University of Utah

Outreach Project Report

Awarded to the teams with the best educational outreach projects in their local community to engage students in STEM (science, technology, engineering and math). Outreach activities should capitalize on the excitement of NASA's discoveries to spark student (K-12) interest and involvement in STEM.

First Place: The University of Alabama
Second Place: Iowa State University
Third Place: Embry-Riddle Aeronautical University

Slide Presentation and Demonstration

Awarded to the teams that best present their project at the competition in front of an audience, including NASA and private industry judges.

First Place: The University of Alabama
Second Place: Case Western Reserve University
Third Place: Virginia Tech

Social Media and Public Engagement

Awarded to the teams that use various social media platforms to engage the public in their participation with MC and engages with NASA and other robotic teams.

First Place: University of Central Florida
Second Place: Iowa State University
Third Place: The University of Alabama

Judges Innovation Award

Awarded to the team that demonstrates the most innovative design.

Winner: Embry-Riddle Aeronautical University

Efficient Use of Communications Power Award

Awarded to the team for using the lowest average data utilization bandwidth per regolith points earned in both the timed and NASA-monitored portion of the competition. Teams must collect the minimum amount of regolith to qualify for this award.

Winner: The University of Alabama

The Regolith Mechanics Award

Awarded to the team with the best example of a real granular innovation that identified a specific regolith mechanics problem (such as the way the soil flows around the grousers, or angle of repose too high in their dump bucket) and intentionally improved their design to deal with it. Courtesy of the Center for Lunar and Asteroid Surface Science (CLASS), part of NASA's Solar System Exploration Research Virtual Institute (SSERVI) Network.

Winner: Worcester Polytechnic Institute
Honorable Mention: University of North Dakota

Caterpillar Award for Autonomy

Awarded to the teams with the most autonomous points averaged from both mining attempts, even if no regolith is deposited. In the event of a tie, the team that deposited the most regolith wins.

First Place: The University of Alabama
Second Place: University of Illinois at Chicago
Third Place: University of North Carolina at Charlotte

Members of the Astrobotics team with Justin and his new ride. Photo credit: University of Alabama

OUTREACH OVERDRIVE

Robotics team goes extra mile for young student

BY AMANDA GRIFFIN

For the past eight years, the University of Alabama's Astrobotics team has fared quite well in the various categories of NASA's annual Robotic Mining Competition. While placing first in many areas such as team spirit, presentation, communications, mining, autonomy, and even first overall for the past two years, the outreach award has proven to be elusive for this competitive team.

After not placing in the outreach category last year, the team redoubled its efforts this year. Four members of the 60-person team didn't just meet the criteria by conducting meaningful outreach to engage others in STEM, they decided to go a bit further by changing one boy's life.

Justin is a 5-year-old at the University of Alabama's Rise school, which works with children with physical disabilities. He was born with a rare condition that resulted in shortened limbs. Justin cannot walk. To get around, Justin must roll or be pushed in a stroller.

Enter Astrobotics. Four team members saw an opportunity to stretch their talents beyond a robotic vehicle fit for Mars — while providing Justin with a whole new level of independence in the form of a small car customized to his unique needs.

"From the first time we met Justin, we quickly learned several things," team member Joseph Kabalin said. "One, he is a very bright kid that could learn to drive the car if we gave him the means to do so. Two, no matter what, we had to make the car work for him because from the first time we met him he was constantly smiling and excited about the car. And three, we knew that no matter how much we personally gained from this project, nothing could compare to what Justin would gain once we gave him his new car."

The team spent seven months working with Justin and his classmates to develop the new control panel, which included a joystick and two push buttons he could easily reach. They outfitted an off-the-shelf battery-operated car with these controls, upgraded the battery to provide a longer charge during playtime and even included a parental control system that allows his parents or teachers to remotely control the vehicle from their smart phones.

This April, the four members of the robotics team who'd worked on the project presented Justin with a means of independent mobility: an Alabama Audi.

Justin now is cruising everywhere in style and, more importantly, on his own. It's all thanks to the engineering spirit of one team not just looking to win a competition -- which they did, finally taking home first place in the outreach category — but looking to make a difference.

"Of all the senior projects we had the opportunity to work on, this project was by far the most meaningful and rewarding project we could have chosen. We were given the chance to work with an incredible young boy and the opportunity to change and improve his life through our work," Kabalin said.

FRESH AIR

Jacobs TOSC technician Rod Ostgard helps fill Portable Breathing Apparatuses, or PBAs, in NASA Kennedy Space Center's Space Station Processing Facility. The PBAs are to be used aboard the International Space Station to provide astronauts with breathable air in the event of a fire or other emergency situation. Photo credit: NASA/Glenn Benson

READY TO CRUISE

Mars rover helps visitor complex kick off new exhibit

BY BOB GRANATH

It looks ike something out of this world, but that's exactly where it would work. A futuristic Mars rover concept vehicle recently was unveiled at the Kennedy Space Center Visitor Complex with a goal of inspiration and education as NASA continues developing plans for its journey to the Red Planet.

The visitor complex kicked off its "Summer of Mars" promotion with a June 5 ceremony that included former astronaut Scott Kelly. During his appearance, Kelly shared some of his experiences during a one-year stay aboard the International Space Station from March 27, 2015, to Feb. 3, 2016.

According to Rebecca Shireman, assistant manager of public relations for the visitor complex, the "Summer of Mars" program will showcase the numerous experiences and activities that focus on the future of space exploration and Mars missions.

"It's an all-encompassing effort to review the history of our efforts to explore Mars and look ahead to what is being planned," she said. "We hope this will encourage young people to want to learn more about being a part of the effort to go to Mars."

NASA's next robotic Mars rover is set to land on the Red Planet in 2020. The Mars 2020 rover will search for signs of past microbial life and collect core samples for a potential future return to Earth. This summer also marks the 20th anniversary of NASA's Pathfinder mission, which kicked off a period of continuous robotic exploration of the Red Planet and the fifth anniversary of the Curiosity rover's landing.

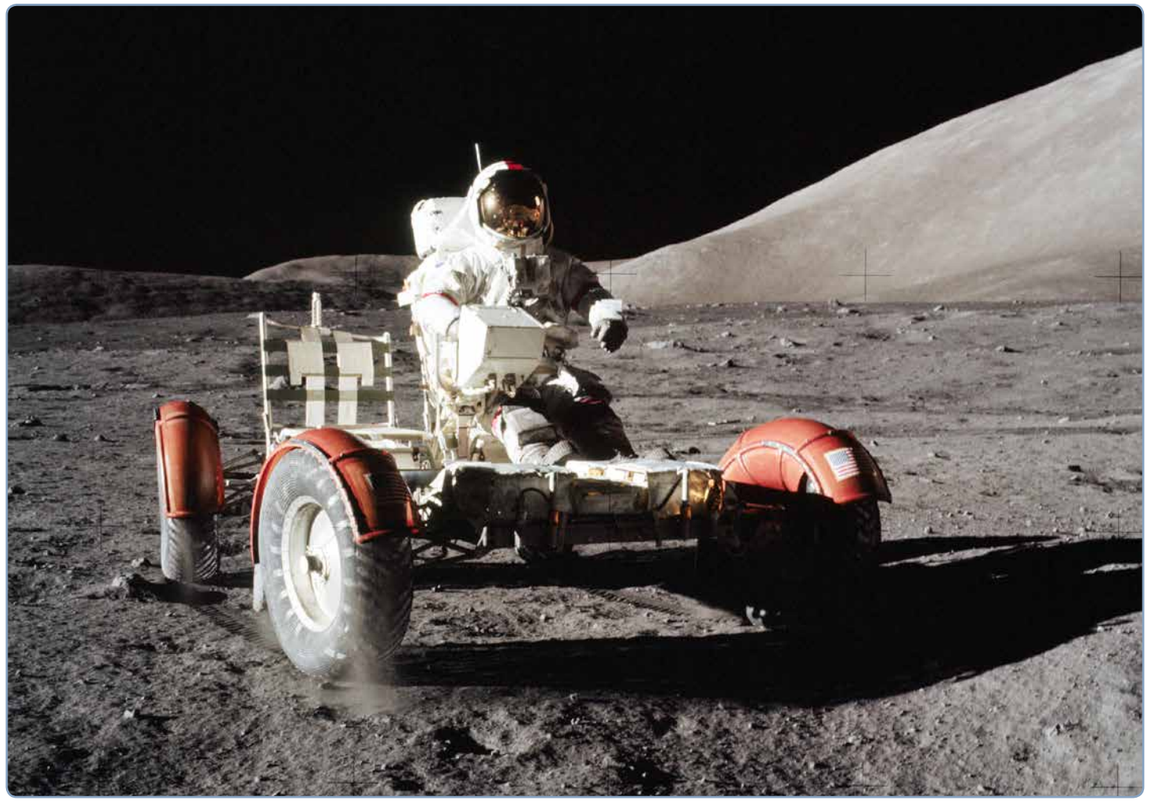
Shireman explained that the "Summer of Mars" has several elements designed to get the next generation of space explorers excited about Mars research and exploration.

"We'll have two new shows, 'Eyes on the Red Planet' and 'Science on a Sphere,'" she said.

The builders of the scientifically themed rover, Parker Brothers Concepts of Port Canaveral, Florida, incorporated input into its design from NASA subject-matter experts. Construction of the Mars rover was commissioned by the Kennedy visitor complex without use of taxpayer dollars.

The rover operates on an electric motor, powered by solar panels, and a 700-volt battery. The rover separates in the middle, with the front area designed for scouting, and is equipped with a radio and navigation provided by a Global Positioning System. The back section serves as a laboratory that can disconnect for autonomous research. While this exact rover is not expected to operate on Mars, it depicts concept features that may someday be incorporated into a rover astronauts will drive on the Red Planet.

Crowds gather around the Mars rover concept vehicle at the Kennedy Space Center Visitor Complex. It is a part of the "Summer of Mars" program designed to provide a survey of NASA's studies of the Red Planet.
Photo credit: NASA/Kim Shiflett



Apollo 17 Commander Eugene Cernan checks out the Lunar Roving Vehicle during the early part of the first Apollo 17 extravehicular activity Dec. 11, 1972. During one traverse across the moon, Cernan reached a top speed of 11 miles per hour. Photo credit: NASA/Harrison Schmitt

The Mars rover is a far cry from the Lunar Roving Vehicles, or LRVs, that aided astronauts during Apollos 15, 16 and 17 in 1971 and 1972.

With a range of about 23 miles, the LRVs were 10 feet long, 7.5 feet wide, 3.75 feet tall and weighed 463 pounds. Power was provided by two 36-volt, silver-oxide batteries. The rovers helped astronauts venture as much as 4.7 miles from their lunar module.

By comparison, the Mars concept rover is 28 feet long, 14 feet wide, 11 feet tall and weighs an estimated 5,000 pounds — about the size of a pickup truck.

During Apollo 17, the LRV operated by NASA astronaut Eugene Cernan reached a top speed of 11 mph.

The Mars rover concept vehicle could move as fast as 60 to 70 mph, but is designed to travel between 10 to 15 mph during exploration. It has six 50-inch-tall, 30-inch-wide wheels designed to accommodate the soil, dunes and rocks of Mars.

The Mars rover concept vehicle operates on an electric motor, powered by solar panels, and a 700-volt battery. The rover separates in the middle, with the front area designed for scouting, and is equipped with a radio and navigation provided by a Global Positioning System. The back section serves as a full laboratory that can disconnect for autonomous research. Photo credit: NASA/Kim Shiflett

Following several weeks on display at the visitor complex, the Mars rover concept vehicle will be displayed at several locations. From July through August, it will be displayed at various locations during a tour along the East Coast.

Shireman explained that the Mars rover concept vehicle will return to the visitor complex to be part of the new Astronaut Training Experience attraction opening in the fall of this year.

“It will be a new opportunity based on NASA’s Journey to Mars,” she said. “Groups and individuals will experience training like a real astronaut using virtual reality and simulators. Training activities include simulations of landing on Mars, walking on its surface, driving on the rough terrain and experiencing microgravity. Children, families and business groups are invited to participate.”

KENNEDY BRACES NATURALLY FOR STORMS

BY STEVEN SICELOFF

Sand dunes were restored in 2014 along a 1.2 mile stretch of shoreline near the launch pads in Launch Complex 39 at NASA's Kennedy Space Center. As part of a six-month effort to help prevent further erosion, 180,000 shrubs, including grasses, sunflowers, vines, sea grapes and palmettos were planted. Constant pounding from tropical storms, such as Hurricane Sandy in October of 2012, other weather systems and higher than usual tides, destroyed sand dunes protecting infrastructure at the spaceport. Photo credit: NASA/Dan Casper

Launch Complex 39B is seen during an aerial survey of NASA's Kennedy Space Center in Florida on Oct. 8, 2016. The survey was performed to identify structures and facilities that may have sustained damage from Hurricane Matthew as the storm passed to the east of Kennedy on Oct. 6 and 7, 2016. Officials determined that the center received some isolated roof damage, damaged support buildings, a few downed power lines, and limited water intrusion. Beach erosion also occurred, although the storm surge was less than expected. NASA closed the center ahead of the storm's onset and only a small team of specialists, known as the Rideout Team, was on the center as the storm approached and passed. Photo credit: NASA/Cory Huston

Massive sand dunes, policies of keeping up-to-date on maintenance and a network of levees are a few of the items in place every day at NASA's Florida spaceport that are critical when storms approach.

With hurricane season under way, officials at NASA's Kennedy Space Center, the Merritt Island National Wildlife Refuge and the Canaveral National Seashore say they are prepared if a massive tropical system moves toward the center this season. Just as importantly, they said, their preparations don't wait for storm seasons, they take place year-round.

"Our 'preparation' is really long-term standard maintenance," said Mike Legare, a supervisory wildlife biologist with the wildlife refuge. "However, if a major storm is coming and forecast to dump lots of water on us, we open the control structures so that water flows out and hopefully reduces flooding and prevents damage."

Hurricane Matthew grazed Kennedy in October 2016, testing the sand dunes that line the oceanside coast of the space center.

"The dunes are there to protect critical launch assets from surges, including those from hurricanes," said Don Dankert, a biological scientist in the Environmental Management Branch of the Center Operations Directorate. "Since there is no way to gauge how a hurricane will strike, officials are forced to be more reactive than proactive."

Launch complexes dot the seashore along the Atlantic Ocean, each one with its own critical components that have to be protected. Some, including Launch Complex 39A and 39B, are built atop structures that would keep rockets and spacecraft far above any storm surge on their own. The dunes and other measures also are vital to keeping a surge from swamping lower-lying equipment around pad perimeters.

The dunes were rebuilt after 2014 when Hurricane Sandy eroded away portions of them. The dunes are critical elements to repel storm surge away from launch facilities and are vital to the seashore for other reasons, too.

"Kennedy's shoreline is an important habitat for wildlife, including several endangered species, such as the Southeastern beach mouse, gopher tortoise and indigo snake."

For the Canaveral National Seashore on the north end of Merritt Island, the focus is on keeping man-made structures such as boardwalks and docks in good shape so they can handle any conditions that spring up. After the storm, plans are in place for surveys and to get any damage repaired.

"We make sure our hurricane plan is up to date," said Laura Henning, the seashore's public information officer. "We perform some preventative tree trimming if time permits."

The levees around Kennedy are designed to keep the marshland around the center from becoming prized territory for mosquitoes. After a storm, when rainwater has built up around the area, extra emphasis is placed on keeping the levels low enough to prevent flooding, but too high for mosquitoes to thrive.

"It is an imperfect but annually very effective technique," Lagare said, "and much preferred over spraying pesticide."

Our Refuge

NASA'S KENNEDY SPACE CENTER NATIONAL WILDLIFE REFUGE

Since August of 1963, Kennedy Space Center has coexisted with Merritt Island's National Wildlife Refuge. Just south of Launch Pad 39A, manatees graze protected in a sanctuary in the northern end of the Banana River. Between May and September, thousands of endangered sea turtles come ashore on this barrier island in the dark of night to lay their eggs. Merritt Island's strategic location along the Atlantic Flyway provides a resting and feeding place for thousands of ducks, wading birds, shorebirds and songbirds. Diverse habitats that include brackish marshes, saltwater estuaries, hardwood hammocks and upland scrub provide homes to an amazing diversity of more than 500 species of fish and wildlife, including many that are protected under the Endangered Species Act. Today, these 220 square miles are managed by the Department of the Interior as a national wildlife refuge and national seashore with the exception of about 10 square miles dedicated to the launch, landing and processing facilities that support the space program. In this Q&A installment about responsibilities of Kennedy's Ecological Program, we provide information on eagle reproductive biology and legal protection. Also included are facts unique to KSC's eagle population. Remember, it is all of our responsibility to leave this planet in better shape than we found it for future generations.

Do eagles stay at Kennedy Space Center year-round?

Some eagles spend the entire year in Florida, but most migrate north during the nonbreeding season (April to August). It is very unusual to see an adult eagle on Kennedy during the summer months.

Q: Where do Kennedy's eagles go during the nonbreeding season?

Florida eagles use three major migration routes: the Atlantic coast, the Appalachian Mountains, and the Mississippi River valley. Most Florida eagles summer near the Chesapeake Bay or in the coastal plain of North Carolina, but some juvenile eagles travel all the way to Newfoundland.

Q: Do bald eagles find a new mate every year like most birds?

It is estimated that 90 percent of eagles stay with the same mate for life, but will take a new mate if something happens to one of the pair. They also consistently use the same nesting territory year after year.

Q: Are bald eagles legally protected?

Eagles were removed from listing under the Endangered Species Act in 2007, but still are federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty.

Q: How old is an eagle when it gets its white head and is able to reproduce?

The average age of adulthood is 5 years, but some eagles have been known to reproduce at 4 years of age.

Q: How long do eagles live?

The average life span is 20 years, and the oldest known record for a wild eagle is 28 years.

Q: What happened to the two eaglets that were rescued from a nest that blew down in March 2013?

The eaglets were rehabilitated at the Audubon Birds of Prey Center in Maitland. The male bird was released into a nest box near its original nesting site at Kennedy, was accepted and raised by its parents, and eventually fledged. Because of partial blindness in one of her eyes, the female eaglet could not be released and was trained as an education bird. She resides at Sea World in San Antonio and is one of their wildlife ambassadors. Star does not do "shows," but is on display at the park and is taken to various public events three to four times per week. She is very well taken care of and is a beautiful, smart bird that seems to be happy interacting with her trainers and the general public.

Q: When do eagles arrive at Kennedy to nest?

For the past several years, eagles have consistently arrived at Kennedy during the third week of August.

Q: How many nests do we have at Kennedy, and how many fledglings are produced?

There is an average of 11 active nests at Kennedy each year (data from 1993-2016) and an average of 11 to 16 fledglings produced (2004-2016).

Q: How old and how big is the eagles' nest on State Road 3 south of the Vehicle Assembly Building?

The nest was built in 1973, but was inactive for the first two years. It has been used almost every year since that time. The estimated diameter of the nest is 7 feet. The "KSC SR 3 nest" is well-known, and drive-bys are a regular part of the Kennedy Space Center Visitor Complex tours.

The pictures are of Star at the San Antonio Sea World. She was 1½ years old in August 2014 and 3½ years old in August 2016.

In the Payload Hazardous Servicing Facility (PHSF) at Kennedy Space Center, the Cassini spacecraft is being lifted onto a transporter Aug. 22, 1997, which will move it to Launch Complex 40 at Cape Canaveral Air Force Station. Cassini is an international mission, conducted by NASA, the European Space Agency and the Italian Space Agency. The two-story-tall spacecraft launched atop a Titan IVB rocket Oct. 15, 1997, and arrived at Saturn on June 30, 2004, to study the planet, its rings, moons and magnetic environment in detail over a four-year period. The Cassini mission is managed for NASA's Office of Space Science by the Jet Propulsion Laboratory, a division of the California Institute of Technology. Photo credit: NASA View a Cassini processing video at **https://youtu.be/gU7KpkVLZ_g.**

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